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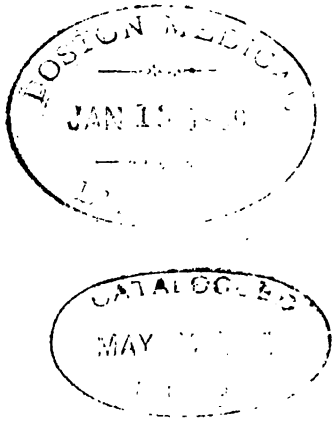

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CHAIRMAN'S ADDRESS

The Laboratory Section of the American Public Health Association

By H. W. HILL, M.D.
Minnesota Board of Health Laboratories
Minneapolis, Minn.

Gentlemen: The Laboratory Section was organized in 1899 for two reasons, both of which were significant of the times.

The first reason was the great development of laboratory work, and the importance which laboratory results had come to possess in public health circles. The rise and growth of the laboratory idea is too well known to all of you for extended reference here.

The second reason was, at first sight, a trivial one. The laboratory men who, before the formation of this section, presented papers to the Association found that they were too often addressing audiences who were not familiar with their vocabulary and saw little immediate significance in the minutiæ that they presented. On the other hand, the audiences complained that the laboratory men wearied them with minute details concerning matters with which most of them had no personal connection. In fact both sides showed some impatience — good-natured and courteous enough — concerning the other, and the obvious, simple and proper pro-

ceeding was to segregate those who wished to talk laboratory matters and those who wished to talk executive matters. This impatience was, after all, perfectly natural. It did but voice something which we hardly recognized ourselves, the coming of recognized specialism, of a profession within a profession, the expert of the test tube and microscope as a recognized and fully developed figure in the profession of public hygiene in this country. The impatience was justified because we all had specialized, and no one specialist can listen patiently to another in minute matters of detail. The formation of a Section on Vital Statistics, now in progress, is a further example of recognition of specialism. As we represent the test tube and microscope, so they represent the specialized mathematics of a technical branch of public hygiene, so technical that most of us cannot follow their vocabulary, so far removed from our subjects that few of us could adequately define the subject if suddenly asked to do so.

It would be far from fair to say or think or allow it to be thought that the establishment of the Laboratory Section initiated specialism. It did but give recognition to it. Specialism was already in existence. We had laboratories and laboratory men, engineers and engineering departments, vital statisticians, epidemiologists, experts in infectious diseases, even in individual diseases, smallpox, yellow fever, etc., in port quarantine, etc., and the specialties of each were recognized. The results of the work of each were listened to eagerly by all classes of public hygienists, but the minute technique of these branches most specialists in other lines would not wish to follow, and generally could not follow if they wished. Of course, every specialist knows that the details of his specialty cannot be made interesting to an audience other than those of his own specialty; for one excellent reason, amongst others, because they have not a common vocabulary. Hence, without meeting places where he can discuss his own work with others in the same lines, the specialist is likely to restrict his public utterances to generali-

ties, or to the application and results of his methods in practice, knowing that for these he can usually find an attentive audience. This state of things reacts upon the specialist, for if he cannot meet his own kind for full discussion, he gradually becomes isolated in thought from his fellows; his own methods and ideas become sacred to himself; he dislikes other people's methods and ideas because they are not his; because merely reading of them, he does not see and understand them, and so he gets off into a world of his own. If every one did this scientific thought would gradually disappear from amongst us *or* the ancient *régime* would be revived, where there was but one man in a century who contributed anything to scientific thought, the rest being mere followers of authority. To do away with all these drawbacks, the section idea was devised, and I for one wholly believe in its value in supplying a center for the specialist where methods and results can be compared and discussed, so that the evolution of the best as the composition of forces at many hands may be attained.

The danger of the section idea lies in the fact that the specialist may find so much satisfaction in discussing technicalities with other specialists that he forgets to make clear the use in the world to which his technicalities should be put. The application and results of scientific work in the world are the real excuse for their existence, at least in applied science, and the laboratory work in public hygiene is pre-eminently applied science. It is for these reasons that I believe we should carry clearly in mind the differences between the internal mechanism by which a certain result is obtained, and the application of that result in practice, so that the laboratory man who discusses in this section the most minute technicalities should not fail to make evident also the value in practice. If this value is evident chiefly in the laboratory, then it should be described here. But no real improvement in technique and no logical and exhaustive deduction from technical results can be made without a

valuable bearing on executive problems. Sometimes the bearing of laboratory advance on executive work is indirect, tending to increased accuracy or rapidity, and hence is a matter chiefly for the laboratory man. But sometimes it has a wider significance, giving to the executive a new method of solving an old problem, or even pointing out a possible solution for an achievement heretofore supposed to be unattainable. Such contributions should be made here as to technicalities, but before the Association as to application and results.

I am accused of tending to the clerical style in fondness for parables, but I will venture on one here nevertheless. The technician bears somewhat the relation to the executive that an expert watchmaker bears to the astronomer, the navigator, the railroad man. It is the technical watchmaker's business to know all about chronometers, mainsprings, escapements and so on. To produce a perfect timepiece, accurate and reliable, is his life, his ambition, his primary reason for professional existence. But the most perfect timepiece, unless used for something, remains merely a work of art, a triumph of mind over matter, a proof of the patience, skill, persistence, mathematical and mechanical knowledge, manual training, etc., of the maker, but that is all. It is true that any wonderfully skillful aggregation of wheels, etc., which now has no use may have a use ten years hence, undreamed of now; but if watches were mere curiosities, which some day might be useful, but for which no use could be found now, few people could afford to work at the watchmaking business, and watches would never have arrived at their present perfection.

The reasons why watches are so perfect, why technical watchmakers of the highest skill exist, are found in the fact that timepieces are essentials to the work of the world.

But the technical watchmaker's interests may stop short with the perfect watch. He may not understand or care for its applications; he need not know anything about longi-

tude to make a perfect chronometer, still less need he be an expert navigator.

If I have made myself clear, this watch parable parallels the whole situation. As the watch itself is a sum total of brains, mathematics, mechanics and technical knowledge, beginning with the crude ores and ending with a perfect timepiece, so the laboratory and its finished products. But as the perfected timepiece when mechanically completed is only at the beginning of its career as a useful factor in the world's work, so the laboratory results must pass into practice and be applied to executive problems if they are to bear real fruit in the progress and welfare of humanity.

If you are not weary of these analogies, I can point out more. Navigation began long before the chronometer was brought to perfection. Great sea captains made great voyages successfully without them. It is true that they navigated by guess and by gosh, but they navigated and did it well under difficulties that would put the modern sea captain out of business. It is true that they did not do the finished, polished, rapid work of the *Lusitania* or the *Deutschland*, but they did it, and all honor to them. Navigation made the chronometer, not the chronometer navigation. But the chronometer made a science of what was at best an art, a matter of tradition, experience and hard straining physical and mental effort. It resulted in division of labor and specialism; the old sea captain did everything, the modern sea captain has a navigating expert who relieves him of that particular technical branch. Meantime other functions previously exercised by the sea captain of all ages have increased in complexity and importance, in the rapidity with which they must be executed, and the scale upon which they must be done. The modern captain of a great liner could not personally superintend every detail, as his ancient predecessor could, partly because there are more details, chiefly because each has become so much greater in mere bulk. The old sea captain might easily call the roll of a dozen men: how can the modern sea

captain call a roll of 800 men? Subdivision of labor is essential to the great mechanisms of today. Principles do not change with mere increase in size, but modes of applications do.

In public hygiene, certainly in those bodies which conduct public hygiene on a large scale, similar subdivision must be carried out. Just how far it must go in each case is a question of local conditions, and depends chiefly on the extent and character of the work attempted. But whenever a definite department, with specialized experts, be they chemists, bacteriologists, engineers, vital statisticians, etc., is established, the executive, in losing a technical function, gains an executive function. The executive is to execute, to accomplish, to apply technicalities to the chief end for which public hygiene exists. The less the executive must personally do of the technical details of inspection, analysis or construction, the better he can attend to the executive function of accomplishment. What then is the final distinction between executive and technical branches of public hygiene, or indeed of any other branch of applied science? It seems to me that distinctions should be made and recognized, for public hygiene is going apace and we must be ready to fit into our proper places. The day of the public hygienist who is chemist, bacteriologist, engineer, vital statistician, lawyer, inspector of nuisances and clerk of his own office is rapidly passing, at least in the larger centers. How best divide the work is the problem of the moment; for although solved in some places, it has not been solved everywhere.

The primary difference between executive and technical is, it seems to me, this: the executive deals with men and their affairs, the technician with things and their affairs. The executive must be a fine technician in handling men; the technician must be a good executive in handling things. Every one knows of good technicians who have not executive ability enough to run a laboratory: every one knows of men of good executive power who have not the proper technique in handling men. The executive is he who makes the final

application of the laws of nature to the solution of a problem concerning mankind: the technician is he who, as lawyer, engineer or chemist, statistician or epidemiologist, analyzes the case, determines the facts and indicates, if he can, the procedure which promises the desired solution.

As in all government, the legislature makes the laws, the judiciary interprets them, determines their application, and points out their effect, while the executive, fully assured on these preliminaries, accomplishes with them the desired result, so in public hygiene, nature makes the laws, the technician interprets, and determines their applicability, the executive applies them to accomplishment. As we see sometimes lawyers so interested in a technicality that they forget that the main object of the law is to do justice, so we see laboratory men so interested in mere technique that its usefulness in the world is lost sight of. As we sometimes see a governor or a president impotent in the face of a national problem, from ignorance or neglect of laws already adequate to their solution, so we see at times executives in our lines who do not know or forget the means for solution of problems which the technician familiar with natural law can supply.

A governor need not be a lawyer in order to meet a national problem, but he should exhaust the resources of his experts in the technicalities of the law before abandoning his problem as unsolvable or waiting for new legislation. So the public health executive need not be a laboratory man, an engineer or a statistician in order to solve public health problems, but he should know the possibilities of each of these technicalities as working forces, and exhaust their possibilities before confessing himself beaten, or attempting to gain his end by roundabout or inadequate, incoördinate methods.

The good navigator need not be an expert watchmaker; but he should know to the last least item the possibilities of his chronometer in navigation. He has technicalities of navigation quite sufficient to occupy his attention, about which the watchmaker may know nothing.

I do not say that a watchmaker may not make better and more valuable chronometers if he understands the purposes to which they are to be put. I do not say that the navigator is a worse navigator because he can repair his chronometer on occasion. I do say that neither need know the whole intricacies of the other's work; and in practice both watchmaking and navigation are now so elaborate and detailed that only one man here and there can be expert enough in both to handle each on the highest expert plane, *i.e.*, to secure from his work the maximum of required result from the minimum of necessary expenditure. The ideal combination is an executive who knows what he wants to do, and the lines of attack to follow; and a technical staff expert enough to follow these lines to completion, placing each finished product in the hands of the executive for use.

If I may sum up, it is my firm belief that all analogy, the experience of the ages, the spirit of coördination and specialism of today go to show that the executive and technical branches of every great machine should be, and by the necessities of the case are, coördinate branches of one whole; and that the specialism and subdivision of labor necessitated by the universal and increasing demands of modern life make it necessary as well as obviously advisable to recognize this fact in public health circles. I believe that our section, as the first technical section of this Association, has, in emphasizing this point, done better service to public hygiene in this than any other way, notwithstanding its accomplishments of no mean order in other directions.

This humble effort of mine addressed to you today has been difficult to prepare and difficult to deliver, especially before an audience personally interested in lines which I have touched on. It will be an utter failure if it fails of its single object, to contribute to a better understanding of the relations of the technical and executive branches to the ultimate advancement of public hygiene as a whole.

A METHOD FOR CALCULATING THE NUMBERS OF B. COLI FROM THE RESULTS OF DILUTION TESTS*

By EARLE B. PHELPS, S.B.
Sewage Research Station, Massachusetts Institute of Technology

Two general methods are available for the preliminary isolation of *B. coli*. The sample may be plated out on a lactose litmus medium and the red colonies counted and fished; or a series of dilutions may be made in a liquid sugar medium, the resulting production or non-production of gas noted, and suitable plates made from the highest dilution giving a positive test. The plate method has the advantage of simple manipulation and of yielding quantitative results. The dilution method, on the other hand, possesses the greater sensitiveness associated with liquid media, but, unless a very large number of dilutions be made, its results are only roughly quantitative. Such results are not suitable for the direct calculation of averages in routine work, nor can they be used directly in purification studies for the determination of "per cent removed."

The nearest approach to any quantitative statement is the one frequently used under such a heading as "per cent of positive tests in 1 c.c."; that is, it is tacitly assumed that, if 25 per cent of the 1 c.c. samples give positive tests, the

* Read before the Laboratory Section, American Public Health Association, at Atlantic City, Sept. 30, 1907.

organism is present once in every 4 cubic centimeters. The mathematics of this reasoning is strictly correct only if the water in question contains absolutely the same numbers day after day, and the results obtained vary from the actual facts more and more the greater the daily fluctuation in numbers. The truth of this statement will become apparent if a hypothetical case be worked out.

With waters that vary greatly from day to day in their *B. coli* content, or with sewages and sewage effluents, a more accurate procedure consists in making such a series of dilution on each sample that both positive and negative tests will be obtained. For example, with a sewage effluent containing, let us say, 1,000 *B. coli* per c.c., dilutions of .01, .001 and .0001 c.c. would generally give two positive and one negative test, although the middle dilution might by chance be negative. There is also one chance in ten of the highest dilution giving a positive test. The actual chance of a negative test on the middle dilution could be determined mathematically by Maxwell's distribution law, but in a case of this kind the chance of an even distribution of the bacteria is sufficiently great to be considered unity for practical purposes.

It is the purpose of the present paper to show that from a series of results obtained in this way, on a water whose bacterial content is varying from day to day, a fairly accurate statement of the average numbers present can be calculated. The accuracy of the result will depend largely upon the number of observations averaged and to a lesser degree upon the uniformity in the actual numbers present from day to day.

The principle upon which this method of calculation is based is this: If a series of dilutions are made from a given water and these dilutions submitted to appropriate tests giving positive or negative results, the most probable value of the actual numbers of organisms present is indicated by

the reciprocal of the greatest dilution giving a positive test. For example, if dilutions of 0.1, .01 and .001 c.c. are investigated and a positive result obtained on the first two and not on the last, the most probable number of bacteria present in the water is 100. From this one test alone it might be inferred that such was not the case. It would ordinarily be stated that the number present was over 100 and under 1,000, with a probable value, perhaps, of 550. Such a statement would overlook the possibility of its being but 50, a one to one chance, or but 10, a one in ten chance. However, the accuracy of any statement based upon this one test would be but slight. Suppose now we have ten such tests with identical results. The ten .001 c.c. portions make one .01 c.c., so we have ten .01 c.c. tests positive and one negative. This practically eliminates the possibility of there being over 100 organisms present per cubic centimeter. If there were more than 100 present the chance of its being absent in .01 c.c. would be very slight, while it would have been found once at least in ten .001 c.c. portion. On the other hand, if samples present were far below 100, consistent positive tests would not have been obtained in .01 c.c.

If, therefore, we write down the reciprocal of the highest dilution giving a positive test as the number of organisms present in a given sample, we shall have selected the most probable value. This merely means that in any single test the value taken may be widely in error, but that the average of 50 or 100 tests will not be far from the truth.

The truth of these statements may best be shown by an example.

Let us assume that during one hundred days a sewage filter effluent was under examination, samples being taken daily and tested in dilution of from .1 to .00001 c.c. We will further assume that on certain ten of these days there were 10 *B. coli* present, on ten other days, 50, and so forth up to 90,000, as shown in the accompanying table. The table then

shows how many positive tests would be obtained at each dilution out of each set of ten made on a sample of a given kind.

B. Coli Actually Present on Each of Ten Days	Number of Positive Tests at Each Dilution Out of a Set of Ten Daily Tests				
	0.1	0.01	0.001	0.0001	0.00001
10	10	1	0	0	0
50	10	5	0	0	0
90	10	9	0	0	0
400	10	10	4	0	0
800	10	10	8	0	0
1,200	10	10	10	1	0
2,000	10	10	10	2	0
9,000	10	10	10	9	0
50,000	10	10	10	10	5
90,000	10	10	10	10	9
153,550	100	85	62	32	14
	15	23	30	18	14

Adding up the columns, we get the total number of positive tests at each dilution and also the number of *B. coli* which, divided by 10, gives the average number for the 100 days. This average is seen to be 15,000 in round numbers. Subtracting the total positive tests at each dilution from the total at the next lower dilution gives the number of times that each test was the highest positive dilution in its set. We see that the 0.1 c.c. was the highest dilution giving the test 15 times, .01 c.c., 23 times, etc. Multiplying these numbers by the reciprocal of the dilution, adding and dividing by the total number of tests, 100, we get the average number 16,000 against the true average, 15,000, thus:

$$\begin{array}{r} 150 \\ 2{,}300 \\ 30{,}000 \\ 180{,}000 \\ 1{,}400{,}000 \\ \hline 1{,}612{,}450 \div 100 = 16{,}000 \end{array}$$

An unusually wide range of values has been taken to show that the method of treatment proposed will give accurate

results even under such severe conditions. Obviously the lower numbers have little effect upon the average. With more uniform figures accurate results are obtained with fewer tests. Thus taking the 50 days with the lower values, 10 to 800, we find the actual average to be 270, calculated 290. Similarly, for the remaining 50 days, the actual average is 30,000, calculated 32,000.

The method is obviously of no value for single tests and finds its most useful application in routine studies in water and sewage purification when it is desirable to determine average numbers over a month or a year in order to calculate the efficiency of the process.

To avoid the use of long decimal numbers for dilution, we may use the logarithm of their reciprocals. Thus a dilution of 0.1 would be 1; 0.01, 2; 0.001, 3, etc. These numbers have an additional meaning. They show the number of zeros to be added to 1, or to any plate count, to get the actual numbers. Thus, for a test positive in dilution 2 and negative dilution 3, we write 100; or, if it were positive in dilution 3, 1,000. Similarly for a plate count, if we get 85 colonies on a plate marked 2, we write 8,500, or, if the number was 3, 85,000. Furthermore, in making the dilution originally, the use of these numbers greatly reduced the chance of error. Each dilution of 1 to 10 increases the factor by 1; from 1 to 100, by 2.

With the use of these dilution factors the operation of the rule which has here been described is very simple. For each daily test we write down 1, followed by as many zeros as are indicated by the dilution factor of the highest positive test. These numbers do not necessarily show the actual number present in the sample tested, but monthly averages made from them are fully as accurate as any other bacterial count. The only precaution to be observed is that in each test the range of dilution shall be so great that at least one positive and one negative test shall be obtained.

DIPHTHERIA DIAGNOSIS

By BURT RANSOM RICKARDS, S.B.
Director, Bacteriological Laboratory of the Boston Board of Health

The peculiar morphology of the diphtheria bacillus, together with the considerable amount of variation in both morphology and staining, would in itself have made this organism one of great interest to bacteriologists aside from its importance as a pathogen. These peculiarities usually deceive the beginner into believing that diphtheria diagnosis is one of the easiest of the routine procedures of public health laboratories, but the illusion is not lasting.

The responsibility resting upon the bacteriological diagnostician is always a heavy one, his decisions being of vital interest, financially and socially, to the patient and his associates, and sometimes bearing almost the relation of a death sentence or a pardon. To a greater degree than usual is this true of diphtheria diagnosis, since so much more depends on an early diagnosis, from both the standpoint of treatment and isolation.

The bacteriological diagnosis of diphtheria is in the vast majority of cases based entirely upon the morphology and staining reaction of the organism. Only in exceptional cases is there time, opportunity or necessity of biochemical tests being made. Prior to the work of Wesbrook on the "Varieties of *B. diphtheriæ*" and the subsequent work by the Committee on Diphtheria in Well Persons under the auspices of the Massachusetts Association of Boards of Health, there was undoubtedly much greater diversity of opinion as to what constituted true diphtheria bacilli than exists today. It is probably not expressing it too strongly to say that the

A, C and D types of Wesbrook are now universally accepted in the best laboratories as absolutely typical. When we get beyond these types, however, there is liable to be a great difference of opinion as to the weight to be placed on the morphological evidence presented; and there thus enters still a not inconsiderable amount of the personal element. Moreover, one is apt to be influenced to a greater or less degree, consciously or unconsciously, by other factors, such as the physician's diagnosis, the clinical signs indicated by him, or possibly by the immediate environment of the patient, as, for instance, when the patient is an inmate of an institution. It is on some of these points that the writer wishes to enlarge.

TYPES TO BE CONSIDERED IN CULTURES FOR DIAGNOSIS.

Since the subject of this particular paragraph has been most thoroughly covered in a recent publication,* and is to be dealt with in a paper before the Association at this meeting, I do not propose to go into the question in any great detail.

Suffice it to say that the writer agrees, in the main, with the article referred to; that he makes a diagnosis of positive on A, C and D forms, that the presence of A_1, A_2, B_1, B_2, C_1, C_2 and E forms are regarded as atypical and another culture requested of the physician, usually with the added statement that "suspicious organisms are present." The other diphtheroid forms are thought worthy of note only in very exceptional cases. To the above should be added the statement that if the A, C and D types are found in only very small numbers, experience has taught that a doubtful report is the wisest course, since such cases, if due to the presence of a very small number of diphtheria bacilli in the throat and not to other causes, often clear up in twenty-four to forty-eight hours, in which case the family is saved the great annoyance of quarantine. Also that when the culture shows absolutely

*Am. Journal of Public Hygiene, Vol. XVII, page 156.

no other forms than A_1 or than C_1 this has invariably on further incubation proved to be true diphtheria, that is, A's or C's have developed. Such cultures are now regarded as positive, but are in fact very rare.

Since a single negative is inconclusive in the face of good clinical evidence, it has been the policy of our laboratory, from the first, to request a second culture in all cases where the physician indicates the clinical diagnosis to be diphtheria or where membrane is reported present on pharynx and tonsil or larynx. Such requests are as a general rule respected, especially if the condition of the patient remains the same as when the first culture was taken or if the symptoms increase.

Of course it is often possible when atypical forms are present to obtain definite positive or negative evidence by isolating the diphtheria-like organisms in pure culture, or by secondary cultures made from the original. Such a process can hardly be carried out as a routine procedure except in those laboratories where the technical force is large in proportion to the amount of work A further question of importance on which lack of time forbids discussion is in regard to the types to be considered positive on swab examinations and five-hour incubations.

TYPES TO BE CONSIDERED IN CULTURES FOR RELEASE.

Is not a bacteriologist justified in placing more stress on the types A_1, A_2, B_1, B_2, C_1, C_2 and E when such types are found in cultures for release than when found in diagnosis cultures? With cultures for diagnosis, a positive report means to the patient either the diphtheria ward of a hospital for contagious diseases or the inconvenience, trouble and expense of an isolation at home. The physician should feel confident that the laboratory will give a positive diagnosis report only on absolute typical forms. In release cases, however, we have the clinical evidence of the virulence of the

organism. Here it would seem as if positive reports on the atypical forms mentioned are occasionally justified, since such a decision need mean, in cities at least, only twenty-four hours before another culture could be reported on, — a slight hardship, perhaps, but justifiable when one considers that the patient if released prematurely might infect others, against which possibility the extra hours of isolation become insignificant. In long-continued cases virulence tests offer a ready means of release, if the organism proves non-virulent.

THE PERSONAL ELEMENT IN DIPHTHERIA DIAGNOSIS.

Wesbrook, in his "Varieties of *B. diphtheriæ*," says: "A complete description of the various factors taken into consideration by a bacteriologist in arriving at a diagnosis is almost an impossibility. Account is taken of size, relation of thickness to length, irregularity of shape and staining reaction, and relation of the bacilli to each other (*i. e.* arrangement).

" These various points probably appeal to different laboratory workers with unequal force, and it is conceivable that one observer is willing to include certain bacterial forms as diphtheria bacilli, because they show polar granules, whilst to another their departure from his recognized limits of shape, size or arrangement prevents such inclusion. Or, conversely, arrangement or relation of the bacilli to each other appeals so strongly to one person that he recognizes certain forms as diphtheria bacilli, which to another are of such a size or shape, or display such staining characteristics as to be ineligible for such classification.

" Whilst in routine initial examinations of clinical cases it is probable that the percentage of disagreement in diagnosis between people accustomed to such work is small, in later examinations of the same cases for release from quarantine, and in the investigation of diphtheria-like micro-organisms

derived from healthy throats, noses or other sources, there is room for greater diversity of opinion."

Where two or more men are employed on the technical staff, a large amount of the personal element may be eliminated by having two or more men examine the slides. In the writer's laboratory two men examine the smears, a third man being called upon in all cases of difference of opinion. This method has the added advantage of keeping each man, by constant practice and the mental stimulation from oversight, up to his highest working efficiency.

INFLUENCE OF CLINICAL AND OTHER FACTORS.

If a bacteriologist is in possession of information bearing on the clinical diagnosis or the clinical symptoms, does not such knowledge, unconsciously perhaps, bias the judgment in those cases where the atypical forms are near the border line? To guard against whatever element of truth there may be in this point, it has been the practice of our laboratory to have the diagnoses made and read off to a person marking the cards before such evidence is seen by the diagnostician, who knows only whether the culture is for diagnosis or release.

In a previous paper* the writer discussed conditions which might occur which might render a correct laboratory report contrary to the apparent clinical facts of the case. The points then considered were, with one exception, those which might arise outside the laboratory and for which the laboratory would in no way be responsible. Certain laboratory factors, however, may tend to give results which, while correct in themselves, are contrary to the true clinical facts.

A. DELAY IN INOCULATING SERUM.

Observations made on only a very small number of cases have led the writer to believe that where swabs taken from true

* Trans. A.P.H.A., 1905, Vol. XXXI, Pt. I, page 349.

diphtheria cases are forwarded to the laboratory, without having been inoculated on serum, a negative result is more liable to be obtained than when the serum is inoculated immediately. This opinion is, it is true, based on but slight experimental evidence, but as it is customary in some laboratories where specimens are received from a distance to furnish swabs only to the physician, this point seems worthy of further consideration.

B. EFFECT OF METAL SWAB WIRES ON GROWTH.

Does not the metal of the swab wires exert an influence on the growth of the diphtheria bacillus if allowed to remain long in contact therewith? The writer and his assistants have noticed repeatedly that where physicians, contrary to directions, have allowed the brass swab wires to remain in contact with the serum, a scanty growth has resulted and in a number of cases negative results been obtained where subsequent cultures, properly handled, have proved positive.

C. INFLUENCE OF THE TIME OF INCUBATION.

It is an unquestioned fact that from five to fifteen hours is usually sufficient incubation for the development of *B. diphtheriæ* in routine cultures. From some personal observations, strengthened by the observations and opinions of Denny, the writer believes that in some cultures where the diphtheria bacillus is perhaps originally largely outnumbered by other non-antagonizing or symbiotic organisms from twenty-four to forty-eight hours may be necessary for the diphtheria bacillus to overcome its unfavorable environment and assume a typical form. This may also be due, as Denny suggests, to auto-intoxication on the part of the rapid growers, finally giving the diphtheria bacillus a chance to develop.

On the other hand, it is sometimes, though not often, the case that typical diphtheria bacilli found on five-hour serum growths are entirely overgrown by antagonizing organisms

if kept in the incubator over fifteen hours (to wit, the overnight plus the five-hour incubation), while cultures made from the positive five-hour growth on fresh serum will show true diphtheria bacilli at the end of the fifteen-hour period.

VIRULENCE TESTS.

During the past winter, diphtheria in Boston has been in general of a rather mild type. This has naturally led to a large increase in the number of "bacteriological cases" with a corresponding increase in the number of requests for virulence tests. In a number of instances it has been noticed in making such tests that different colonies from the same original culture have varied greatly in virulence. If this had not repeatedly occurred it would be natural to ascribe such varying result to a difference in the resistance of the guinea pig, but similar results on pigs from varying sources leaves the question an open one.

INTERPRETATION OF RESULTS.

As this topic has been admirably treated in articles published by Hill and others, it is not my purpose to more than mention it here. In brief, the laboratory report should be an absolutely accurate report of what is found after the specimen has been treated according to the very best technique possible. The physician should, but often does not, appreciate that a single negative is inconclusive and that an absolutely accurate laboratory diagnosis may be at variance with the clinical evidence for the following reasons:

1. Through faulty technique on the part of the physician.
2. Through exceptional vital resistance on the part of the patient.
3. Through low virulence of the organism.

In conclusion, the problems suggested in this paper are, as you are well aware, but a small part of those with which the

worker in this field has to deal. Hoag's *Bacillus X* has been met with during the past winter in many ear cultures, often pure, sometimes associated with *B. diphtheriæ*. A culture containing this organism is often most puzzling and might even be regarded as positive unless one was thoroughly familiar with the points of differentiation. This organism and the other so-called pseudo-diphtheria forms deserve a great deal more study. Both in organization and technique in diphtheria diagnosis and in the other lines of diagnostic work there are many problems to be attacked and a need of greater uniformity in present methods.

In view of the success attending the efforts of the Technical Committee on Water and on Milk to secure standard methods of procedure, I would move, if in order and in accordance with the provisions of our constitution, that a Technical Committee be appointed on Diphtheria Diagnosis, to consider the subject from the various standpoints of organization, coördination, technique and interpretation of results.* The method of appointment and the number of members I would leave to the Chair, but would suggest the advisability of having the Committee as fairly evenly divided as possible between State and municipal officials, in order that the various conditions met with, in these two branches of the service, may receive due consideration.

In other branches of diagnostic service there is also more or less need of similar work. I would suggest to the Section the value of having committees appointed to consider such subjects as Tuberculosis, Typhoid, Glanders, Rabies and the like, and such new work as *Spirochæta pallida*, the Conradi-Drigalski method of diagnosing typhoid, etc., with the object in view of securing uniform methods, investigating new methods, discussing the interpretation of results and in general coördinating the whole service.*

* Action taken as indicated in the Report of the Committee on Technical Progress; this Journal, Vol. XVIII, page 168.

EFFECT OF HEATING UPON THE DETERMINATION OF LEUCOCYTES IN MILK

By H. L. RUSSELL and CONRAD HOFFMANN
University of Wisconsin

In the matter of examining milk for cellular elements, considerable emphasis has been laid on the method of examination. The two methods in vogue, (1) smearing the sediment on a glass slide, (2) the examination of the sediment in a blood-counting apparatus, have each had their advocates. In our experience we have found the latter method (Doane-Buckley) much the more accurate.

There are, however, other considerations that have heretofore been neglected that affect to a marked degree the accuracy of either method of examination. In studying the leucocyte content of raw and pasteurized milks one finds that the heated milks almost uniformly show a considerably larger number of cellular elements than the unheated product. Our attention was first called to this matter by Dr. B. H. Stone of the Vermont Laboratory, who inquired whether we had noted this condition in our leucocyte work.

A series of studies was made to ascertain the correctness of this observation, and the following results were obtained by the volumetric method on the same sample of milk from individual animals in a heated and unheated condition. The sample was divided and one portion heated to 70° C. The percentage increase or decrease of the heated sample is shown in the last column of the table.

TABLE I.

CELLULAR CONTENT OF HEATED (70° C.) AND UNHEATED MILKS

NUMBER OF COW	CELLULAR CONTENT PER C.C.		PER CENT OF INCREASE OR DECREASE
	Unheated	Heated to 70° C.	(Unheated as Standard)
7			
Fore	122,500	71,375	— 71.6
Middle	210,000	231,250	+ 10.1
Strippings	185,000	356,250	+ 92.5
32			
Fore	66,250	200,000	+ 201.8
Middle	178,750	297,500	+ 65.3
Strippings	356,250	625,000	+ 75.4
24			
Fore	101,250	77,500	— 30.6
Middle	55,000	41,250	— 33.0
Strippings	160,000	117,500	— 36.1
Whole	62,500	81,250	+ 30.0
32			
Fore	272,500	335,000	+ 22.9
Middle	256,250	270,000	+ 5.3
Strippings	985,000	1,291,250	+ 30.0
Whole	247,500	288,750	+ 17.0
17	770,000	937,500	+ 20.7
11	500,000	701,250	+ 40.2
9	850,000	901,750	+ 6.0
45	137,500	117,500	+ 29.0
	96,250	102,500	+ 6.4
	132,500	131,250	— 0.9
46	56,250	53,750	— 4.6
	14,070	18,750	+ 33.3
	14,070	23,440	+ 66.6
47	18,750	18,750	+ 0.0
	4,690	12,500	+ 166.5
	6,250	4,690	— 33.2
48	462,500	520,000	+ 11.2
	253,750	357,500	+ 40.8
	388,750	387,500	— 0.2
26	3,125	12,500	+ 300.0
35	11,560	28,125	+ 143.2
34	25,000	72,500	+ 190.0
32	118,750	207,500	+ 74.7
7	82,500	203,750	+ 146.9
18			
Fore	370,000	681,250	+ 84.1
Middle	341,250	506,250	+ 48.5
Strippings	1,206,250	1,956,250	+ 193.1
24			
Fore	36,250	106,250	+ 193.1
Middle	50,000	45,000	— 11.1
Strippings	73,750	138,750	+ 88.1
24	133,750	135,000	+ 0.9
43	625,000	782,500	+ 25.2
18	632,500	741,250	+ 17.1
7	207,500	250,000	+ 20.4
18	656,250	781,250	+ 19.1
28	20,000	26,250	+ 31.2

TABLE I.—Continued

CELLULAR CONTENT OF HEATED (70° C.) AND UNHEATED MILKS

NUMBER OF COW	CELLULAR CONTENT PER C.C.		PER CENT OF INCREASE OR DECREASE (Unheated as Standard)
	Unheated	Heated to 70° C.	
41	113,750	153,750	+ 35.1
40	36,250	48,750	+ 34.7
9	479,375	800,000	+ 66.6
7	51,875	118,125	+ 127.7
17	724,075	1,281,250	+ 76.8
9	545,625	610,000	+ 11.7
43	253,750	254,375	+ 0.2
7	136,875	228,125	+ 5.9
32	52,500	75,000	+ 42.8
18	244,375	278,750	+ 14.0
11	193,750	316,250	+ 63.2
33	228,750	370,000	+ 66.1
24	48,750	172,500	+ 253.8

In sixty examinations here reported, fifty show an increased number of cell elements in the heated sample, and the percentage increase is usually so marked as to indicate, beyond all question, that the difference exceeds the usual limits of analytic error. In all but five cases where the heated sample showed less than the raw sample, the difference was well within the analytic error.

To ascertain the cause of this difference a series of samples was examined where they were heated at different temperatures ranging from 50° to 80° C. Thirty-one samples were thus examined with a determination of the number of cells in the raw milk as a control. Without giving the detailed figures here obtained, it was determined from this data that the most marked variation in cell content occurred between the temperatures of 60° and 70°. Not infrequently a marked difference was also found to exist between the unheated sample and that heated to the lowest temperature. The difference between the extremes of temperatures in favor of the heated sample was to be noted in every case but one.

The well-known change which occurs in pasteurized milk,

whereby the fat globule clusters are broken down, is evidently associated with this change.* When milk is heated for ten minutes at 60° C. the creaming power is greatly diminished. The fat globule clusters are broken down and the butter fat is more or less homogeneously distributed throughout the milk serum. These fat globule aggregations rise readily to the surface, and probably entangle a good many of the cell elements; but with the more homogeneous emulsion of the fat, due to the action of the heat, the leucocytes are probably not enmeshed and are therefore free to respond to the action of gravity.

If this explanation is true, the cell elements in skim milk from whole milk allowed to cream perfectly ought to be less numerous than where imperfect separation occurs. On this point a series of examinations was made in which the milk of different animals was allowed to cream for 24, 48 and 72 hours respectively, after which an examination was made as to the leucocytes present in the whole milk, and also in the cream and the skim milk. Four tests were made for 24 hours, fifteen for 48 hours and six for 72 hours. The data obtained indicated that where the cream was allowed to rise completely, by far the larger proportion of the cellular elements was present in the cream, in spite of the fact that they were sufficiently heavy to fall to the bottom of the vessel if gravity alone were the only factor operative.

If the milk is previously heated, even the action of gravity is able to cause the sedimentation of a much larger number of leucocytes than is the case in unheated milk. The samples for this purpose were taken from five animals and portions of whole milk, cream and skim milk examined with and without previously heating. The marked decrease in the number of cells in the cream in every case and their accumulation in the skim milk indicate the effect of this physical condition.

* Babcock and Russell, 13th Report, Wisconsin Experiment Station, 1896, p. 77.

To complete this study determinations were made upon the cell content of whole milk (raw and heated) and the supernatant cream and skim milk that are removed after the sedimentation of the leucocytes. In sedimenting the cell elements in the supernatant fluid removed by aspiration, water was used as a menstruum by which the leucocytes could be more effectually removed. The following data in Table II show the wide difference in per cent of all elements in the cream and milk after the first centrifugal process:

TABLE II.

CELL CONTENT IN HEATED AND UNHEATED WHOLE MILKS AND SUPERNATANT LIQUID AFTER FIRST PRECIPITATION

TREATMENT OF MILK	LEUCOCYTES PER C.C.		
	Whole Milk	Supernatant Cream and Skim Milk	Per Cent of Original Number in Whole Milk Found in Supernatant Liquid
Unheated	529,375	12,500	2.3
	589,375	62,500	10.6
	723,125	28,125	3.8
	319,375	29,690	9.3
	548,500	37,970	6.9
	228,750	25,000	10.9
	197,200	92,500	46.9
	365,625	26,250	7.1
	271,250	137,500	50.6
	12,875	9,375	72.0
	12,500	7,340	58.7
	280,000	77,500	27.6
	338,125	100,000	29.5
	625,000	46,875	7.5
			Av. 24.5%
Heated to 70° C.	200,000	6,250	3.1
	297,500	25,000	8.4
	625,000	26,250	4.2
	782,500	20,315	2.6
	413,750	25,000	6.0
	268,750	3,125	1.1
	638,125	21,875	3.4
	386,875	21,250	5.4
	825,625	9,375	1.1
	634,375	14,840	2.3
	638,125	9,375	1.4
			Av. 3.54%

These determinations leave no doubt but that many of the cell elements in milk are not recovered in the sediment produced by centrifugalization under customary conditions. Any method where the loss varies from 2 to 70 per cent due to the effect of a single factor is open to serious objections. Such criticism cannot be urged in the case of the heated milks, as an analysis of the same factor of loss here reveals an average of about 3.5 per cent with a range, as indicated, from 1.1 to 8.4 per cent.

To show how small the analytical error in duplicate examinations of heated milk samples is, the following data from our records are herewith appended:

TABLE III.

CELL CONTENT OF DUPLICATE SAMPLES OF HEATED MILK (70° C.)

NUMBER OF COW	FIRST EXAMINATION	SECOND EXAMINATION	PERCENTAGE VARIATION
7	72,500	71,250	1.7
11	263,750	270,000	2.3
11	616,250	660,000	7.1
17	391,250	382,500	2.2
17	812,500	838,750	3.2
9	643,750	625,000	3.0
9	635,000	641,250	1.0
19	1,316,250	1,316,250	0.0
11	522,500	513,750	1.7
41	2,506,250	2,518,750	0.5
9	868,750	863,750	0.5
18	395,000	382,500	3.2
17	656,250	653,750	0.3
8	166,250	187,500	12.7
37	58,750	53,750	9.3
38	65,000	61,250	6.1
42	1,697,500	1,695,000	0.1
13	15,625	15,625	0.0
35	123,750	122,500	1.0
33	306,250	312,500	2.0
18	435,000	432,500	0.5
9	1,702,500	1,715,000	0.7
			Av. 2.7%

These unselected results, taken from our regular determinations, certainly indicate as consistent records as could be desired.

It would appear from the foregoing data that in determining the number of cell elements in milk it is advisable to subject the material to an initial heating to a point where the creaming power of the liquid is broken. A momentary exposure at 70° C. or above, or a more prolonged heating for a few minutes at 60° C., will so alter the physical arrangement of the fat globules in milk that practically all of the cellular elements may be recovered. Such an improvement in technique is to be regarded as advisable in conducting studies on the cellular content of milk.

IMPRESSION PREPARATIONS AND THE VAN GIESON STAIN FOR NEGRI BODIES*†

By LANGDON FROTHINGHAM, M.D.V.
Instructor in Bacteriology, Harvard Medical School

(*From the Bacteriological Laboratory*)

In the Journal of Medical Research for April, 1906, Volume XIV, New Series Volume IX, I published an article on "The Rapid Diagnosis of Rabies," in which I recommended the use of impression preparations from fresh Ammon's horn or cerebellum tissue fixed for a short time in Zenker's fluid and then stained with methylene blue and eosin. By this method the Negri bodies may be beautifully demonstrated in about one hour.

Shortly after the publication of this article Drs. Williams and Lowden, Journal of Infectious Diseases, May, 1906, Volume III, recommended the smear method of diagnosis, the smears stained in various ways, the most successful being Van Gieson's stain. This stain as then published was:

Water	10 c.c.
Saturated alcoholic fuchsin (Grübler) . . .	2 drops
Saturated aqueous methylene blue (Grübler)	1 drop

This method was communicated to me verbally in June,

* Read before the Laboratory Section, American Public Health Association, at Atlantic City, September 30, 1907.

† Langdon Frothingham. Zur Schnellen Darstellung Der Negrischen Körperchen. Zeitschrift für Tiermedizin. Volume XI, 1907, p. 378.

1906, and since then I have used it with most excellent results in staining my impression preparations.

The impression preparation, however, has a great advantage over the smear or crushed tissue preparation recommended by Williams, namely, that the characteristic arrangement of the large nerve cells of the Ammon's horn is practically undisturbed by this method, and consequently one obtains a most excellent substitute for a section. Moreover, if Negri bodies are few in number, they will invariably be found in the large cells lying just outside the hylus. In impressions these cells are almost as readily discovered with a low power as they are in sections, and they are the first cells one should examine for Negri bodies. One looks for them in a perfectly definite situation, which of course cannot be the case in a smear preparation. In fact a successful impression preparation of the Ammon's horn is as good and usually better than a section for demonstrating these Negri bodies. The same is true to a certain extent of impressions of the cerebellum, although the Purkinje cells are not as numerous as in a section, nor as regularly distributed. Impressions of different parts of the cerebrum are also most satisfactory.

I have used impression preparations so frequently and so successfully with this stain of Van Gieson's that I believe it is quite unnecessary, in case Negri bodies are not found in them, to study sections. In my earlier communication I stated that, if Negri bodies were not found in impression preparations of Ammon's horn stained by the method then recommended, that it was wise to study Zenker fixed sections stained in the same way, as occasionally I had been able to find a few bodies by the section method, which had not been possible with the impressions. But since using the Van Gieson stain this has never been the case. In fact where bodies are few in number, they are not only comparatively more numerous in impression preparations stained in this manner, but are much larger and consequently more easily

discovered than in Zenker fixed sections stained with methylene blue and eosin.

The method is so simple and rapid and the results so remarkable that I give it in detail, and also add my method of removing a dog's brain, as it differs essentially from the usual practice.

1. Remove the calvarium. I find a wooden mallet and the hatchet chisel (Mallory & Wright) most satisfactory for this purpose, and never use a saw on a dog's head. Having dissected back the skin and removed the muscles as close to the skull as possible, place the chisel facing downwards and at right angles to the nose upon the anterior part of the skull, a little anterior to the point of the V (depending upon the kind of dog) formed by the union of the frontal and parietal bones. A few sharp blows of the mallet will suffice to crack the skull, the fissure caused thereby extending downwards and often somewhat backwards on both sides. Place the point of the chisel at the base of the fissure on one side and cut backwards through the parietal and occipital bones (the cut may go through a portion of the temporal bone). Repeat on the opposite side, and the calvarium can now easily be pulled upwards and backwards with the chisel, and removed after the muscles still holding it at the base of the occipital bone are cut with a knife. Divide the dura with scissors and lay back on either side. Stand the dog's head on its nose (the nose being placed upon a board or close to the edge of a board, which should be about ten inches square and three-quarters of an inch thick). Tilt the head slightly forward, the exposed brain being towards the operator. Gravity now draws the brain downwards and outwards, and with slight assistance of forceps and curved scissors (first dividing the spinal cord just back of the cerebellum) the whole brain falls out upon the board. (When the work is completed, this board, holding the dissected brain, is put into the steam sterilizer.)

2. Beginning at the olfactory bulbs divide the cerebrum

and cerebellum into two halves by cutting along the median line with the scissors.

3. From one-half cut off the cerebellum close to the cerebrum; open the lateral ventricle, thus exposing the Ammon's horn.

4. Dissect out the Ammon's horn with the scissors, and remove the unnecessary tissue from the edges. Then with scissors cut out a small disc at right angles to the long axis of the organ, from any part desired, and place it upon the board near its edge, so that one of the flat surfaces of the disc rests upon the board, the other of course being exposed. The peculiar and definite arrangement of the desired nerve cells is now seen as distinct white lines.

5. Place a thoroughly cleaned slide upon this disc of tissue. Press gently and lift suddenly. (The wood being more porous than the glass the tissue invariably remains upon the board, leaving an impression of its surface upon the slide.) Repeat, using a new portion of the slide and a little more pressure. A third impression is made by using still more force, and a fourth by using sufficient pressure to almost completely flatten the disc.

6. Before these impressions have dried place in methyl alcohol for one-half to two minutes or longer.

7. Remove from the methyl alcohol and cover with Van Gieson's stain. (It is unnecessary to wait until the alcohol has evaporated.) Warm gently for one-half to two minutes, over a small flame, until a thin vapor arises.

8. Wash in water, dry with filter paper and examine without cover glass, using a low power to orient the preparation, in order to discover where the largest and best cells lie, and these are immediately examined with the oil immersion.

Naturally some impressions are better than others, depending upon various conditions. For example, perfectly firm, fresh tissue gives as a rule a poorer impression than a tissue

which has become slightly softened. Also, if the brain is solidly frozen, which often is the case when animals are forwarded in winter, it should be allowed to thaw before it is removed from the skull. Otherwise it is most difficult to properly dissect out the Ammon's horn, and impressions made from it while still frozen, or immediately after it has thawed, are apt not to be good, owing to the excess of moisture. On the contrary, if the organ has slowly melted in situ, most excellent preparations are apt to result. Moreover, all of the impressions may not be equally good. Consequently I always make four, and, as a rule, at least one of these will be so satisfactory that the entire cell arrangement of the Ammon's horn may be made out with almost as much ease as in a section, though many of the cells, of course, are crushed and broken, and many bodies may be found outside of the cells.

It occasionally occurs that in such preparations of Ammon's horn no Negri bodies can be found, yet in the Purkinje cells of the cerebellum they may be present sparingly or indeed in large numbers. Therefore, it is my practice to make, in addition to the four impression preparations of Ammon's horn, two of the cerebellum, all upon the same slide, from each suspicious case of rabies, which I have to examine. Preparations from the cerebellum are easily made from the cellular portions of the organ.

Moreover, it very occasionally occurs that neither in the Ammon's horn nor cerebellum Negri bodies can be found, yet they may be demonstrated in the cerebrum. The best portion of this organ to examine in the dog is perhaps the region of the Fissura Cruciate, and impression preparations from this portion are usually very successful.

Van Gieson's stain as told me was made as above mentioned, but shortly after I began its use I observed that often the cell protoplasm was stained too intensely blue, and I found that I obtained uniformly better results by making the stain up as follows:

Water (faucet water)	20 c.c.
Saturated alcoholic solution of fuchsin . . .	3 drops
Saturated aqueous solution of methylene blue.	1 drop *

The stain should be made up freshly every day, as the Negri bodies fail to take up the red readily after the solution is six to eight hours old.

The Negri bodies stain from a pale pink to a purplish red and often contain numerous minute dark blue dots. The cells stain more or less blue, the red blood corpuscles not at all or are yellowish in color, rarely pinkish.

I would like to call attention to the following staining peculiarity, namely, that not infrequently the Negri bodies in the Purkinje cells stain a very pale pink, while those in impressions of the Ammon's horn, made upon the same slide and stained at the same time, are deeply stained. I have also observed this same peculiarity in the sections.

Having examined several hundred brains for Negri bodies and having tried many different methods, I recommend today above all others for the rapid staining of the Negri bodies, and, therefore, for the rapid diagnosis of rabies, Van Gieson's stain combined with my impression preparations, but in order to bring out to the best advantage the finer structure of the bodies, I prefer my earlier method, namely, Zenker fixed impression preparations stained with eosin and methylene blue.

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* Van Gieson in his article in the Centralbl. f. Bakt. Erste Abt., Bd. XLIII, Heft 2, gives his present stain as follows:

Saturated alcoholic solution of rose anilin violet	2 drops
Saturated aqueous solution of methylene blue	1 drop
Distilled water	10 c.c.m.

NORMAL WATERS OF ILLINOIS*

By EDWARD BARTOW

The State of Illinois, extending, as it does, three hundred and seventy-eight miles from north to south and two hundred and seven miles from east to west, presents a varied geological character. There is a dip in the geological strata from north to south, and glacial drift covers more than two-thirds of the State. These features influence the character of the water, causing great variations.

In determining the normal waters, the following divisions, suggested by Professor A. W. Palmer, may be made:

1. Surface waters, including rivers, lakes and ponds.
2. Springs.
3. Shallow wells.
4. Deep wells in drift.
5. Deep wells in rock.

Observations of the municipal water supplies show the distribution of these classes of water throughout the State. These are indicated on the map. Deep rock wells are used most commonly for water supplies in the portion of the State north of a line drawn from Quincy to Chicago. The deep drift wells are used most commonly in the territory bounded on the north by the above-mentioned line, and on the south by a line drawn from Danville to the Mississippi River, just below St. Louis. South of the second line the great

* Abstract of paper read before the Laboratory Section, American Public Health Association, at Atlantic City, Sept. 30, 1907.

majority of the cities obtain their water supplies from rivers or reservoirs.

A study of the mineral content of the deep rock wells shows that the amount of mineral matter in the water increases from north to south, reaching its maximum in the wells along the line drawn from Quincy to Chicago. South of this line the deep rock wells, reaching down into the St. Peter's and Potsdam sandstone, contain so much mineral matter that they are useless as sources of water supply. A few of the deep rock wells to the south in other strata furnish satisfactory water. The variation in the usual sanitary chemical data obtained by analyzing these deep rock well waters is so great that the normals can be determined only by careful study of waters from many wells, and by classification according to the strata from which the waters come.

The variations are nicely illustrated in the table of analyses of water from deep rock wells. The table shows analyses of water from three wells in the northern portion of the State, and of one good water (Belleville), and one water with high mineral content (Lawrenceville), from the southern portion of the State.

ANALYSES OF WATER FROM WELLS OVER FIVE HUNDRED FEET DEEP IN ROCK

Laboratory No.	13785	15603	15[illegible]3	15687	15503
Town	Elgin	Marseilles	Streator	Belleville	Lawrenceville
County	Kane	La Salle	La Salle	St. Clair	Lawrence
Depth	2,000 ft.	600 ft.	1,11[illegible] ft.	1,500 ft.	1,710 ft.
Turbidity	20.	Clear	Very light	Clear	Very decided
Color	1.0	.2	[illegible]	.2	Brown
Odor	0	0	[illegible]	0	Kerosene
Residue on evaporation	376.	464.	2,41[illegible]	401.	29,108.
Chlorine	3.5	61.	1,00[illegible]	16.	17,400.
Consumed oxygen	4.0	2.25	.45	1.75	46.3
Nitrogen as free ammonia	1.08	.080	.280	.008	3.44
Nitrogen as albuminoid ammonia	.192	.032	.016	.048	.056
Nitrogen as nitrites	.000	.004	.250	.008	.000
Nitrogen as nitrates	.24	.400	.070	.752	.280
Alkalinity	323.	297.	[illegible]3.2	297.	407.9
Bacteria per c.c.	0	0	[illegible]5.	50+.	730.
Colon bacillus in 1 c.c.	Absent	Absent	[illegible]bsent	Absent	.....

Wells in the drift are also variable. This is especially noticeable with respect to oxygen consumed, and free or saline ammonia. The excessive free ammonia in these drift wells cannot indicate recent pollution, as it is not accompanied by an excessive number of bacteria nor by the colon bacillus. The waters from the glacial drift usually become turbid on exposure to the air, and should be aerated or otherwise treated before they are allowed to enter the mains. An investigation of their properties becomes, therefore, a study of their inorganic content. According to their inorganic content, these drift waters, and the other waters also, can be divided into two classes, as there is, or is not, more than enough sodium present to combine with all the nitrate, chlorine and sulphate ions. Those containing an excess of sodium ions may be successfully treated with lime. Those which do not contain an excess of sodium can be more satisfactorily treated by the addition of sodium carbonate or hydrate with the lime.

The streams which are practically all sulphate waters are now normally impure, and should at least be filtered before being used for water supplies. An investigation of their properties becomes also a study of their inorganic content, together with the suspended matter. Examinations of Illinois rivers at twenty-seven stations show a higher turbidity in the rivers to the south. The Kankakee River, rising in swamps in northern Indiana, is least turbid, but has the highest sulphates. The chlorine in all cases varies somewhat with the season, but the general averages do not differ materially.

To summarize, in deep rock wells we find great variation in mineral content. In the northern part of the State, where most of them are found, this mineral content increases from north to south. The deep drift waters are so variable that the usual sanitary tests for free ammonia and consumed oxygen have little value. The streams are all more or less

turbid, the turbidity being more persistent to the south, and all the streams must be treated by filtration or sedimentation before they can be used for drinking purposes.

Finally, from the data now at hand, the conclusion must be drawn, that not only no general normal can be established for the State, but also that no general normal can be established for each class of waters.

NOTE ON METHOD OF DETERMINING TOTAL AND VOLATILE SUSPENDED MATTER IN SEWAGE*

By C. B. YOUNG and C. F. LONG

In following the method of Kimberly and Hommon for the determination of suspended matter in sewage, as outlined in Public Health, Volume 31, Part II, page 123, the workers in this laboratory experienced some difficulty with the method in that, after ignition of the suspended matter, the weight of the crucible and ignited suspended matter would fall below the initial weight of the crucible and mat alone. The writers had this difficulty with a large number of determinations, and a very large number showed abnormally high values for volatile matter, indicating that loss was taking place somewhere.

In order to dispose of the danger of the asbestos still containing some soluble matter, and to satisfy ourselves that no particles of the mat were passing through the Gooch when suction was applied in filtering, thereby causing a loss on the first weighing (before ignition), several mats were prepared in the usual manner and ignited at a low temperature for five minutes, washed with from 100 to 200 c.c. of distilled water, dried in the air bath and reweighed. The second weighing in each case checked the first, thus showing that no soluble matter was being dissolved from the mat and that no particles were being pulled through by the suction.

In the preparation of the asbestos, the washing by de-

* Contribution from the Laboratory of the Ohio State Board of Health. Read before the Laboratory Section, American Public Health Association, at Atlantic City, September 30, 1907.

cantation is very slow, as the asbestos settles slowly and loosely, and it was found preferable to stir up the asbestos with water in a beaker, then pour off through a perforated plate placed in a large funnel, finally transferring the whole contents to the funnel and allowing it to drain. Then place the asbestos back in the beaker and stir up with water and transfer to the funnel as before. By this method one does not have to wait until the asbestos settles; a much larger proportion of the washed water is also removed, thus greatly diminishing the number of washings and amount of water necessary to wash the asbestos. The cream used should contain enough asbestos that in order to make a mat of proper thickness 50 to 100 c.c. of the cream must be poured through the Gooch. Then, in order to make sure that no particles of the mat be drawn through in filtration of the sample, it is well as soon as it is formed to pour some distilled water through. We have not found that this precaution is necessary, but for new workers we would advise it.

During the course of the work various kinds of asbestos were used and experimented with, in order to determine which might be the best adapted to the above procedure. The kind finally selected was the ordinary "long fibrous asbestos," which was prepared by us as follows: Digest with strong hydrochloric acid on water bath, and then wash from the acid till the washings give no test for hydrochloric acid with silver nitrate. It was found that a mat prepared from this product, thoroughly ground in water, was effective in catching all the finely divided suspended matter.

For ignition of the Gooch crucible and asbestos filter an iron radiator was used, heated with two ordinary Bunsen burners. By this method the iron radiator was heated to dull redness, as described by Kimberly and Hommon. It was thought very probable that insufficient initial heating was the cause for the loss on ignition of the suspended matter. In order to remedy the above defect, a small nickel dish was

used, but the same difficulty was experienced. Although the ignition was continued fifteen to thirty minutes, loss continued to take place with final ignition. When, however, the blast lamp was used on the nickel radiator for ten minutes no further loss took place, and no further difficulty was experienced in securing satisfactory results. It was found that vigorous blasting for ten minutes drives off all volatile matter, and when the crucible is placed in the nickel radiator the blasting does not disturb the asbestos in any way. Ignition must be strong enough to give a very distinct red glow to the crucible itself.

The following results, which were taken from the daily notes in this laboratory, will serve to demonstrate the above:

	FIRST IGNITION	SECOND IGNITION	THIRD IGNITION	FOURTH IGNITION
Ignition for ten to fifteen minutes in iron radiator heated with two Bunsen burners.	11.8758 12.6525 12.8997	11.8742 12.6317 12.8993	11.8742 12.6314 12.8988	11.8740 12.6312 12.8985
Ignition same as above, except in nickel dish.	12.9445 12.6323 12.8734	12.9434 12.6317 12.8717	12.9433 12.6305 12.8714	....
Strong ignition for ten minutes in nickel dish heated with blast lamp.	12.1321 12.2020 12.5335 12.8037	12.1321 12.2020 12.5335 12.8037	12.1321 12.2020	....

Preliminary Statement by the Committee on Standard Methods of Bacterial Milk Analysis

To the Laboratory Section of the
AMERICAN PUBLIC HEALTH ASSOCIATION

ABSTRACT

At the meeting of the Laboratory Section of the American Public Health Association in Boston in 1905, at the suggestion of Prof. S. C. Prescott of the Massachusetts Institute of Technology, a Committee (of which Prof. Prescott was made Chairman) was appointed to study the various methods used for the bacteriological examination of milk and to recommend a uniform procedure.

A circular letter asking for information as to existing methods and technique used in bacteriological milk examinations was sent to leading bacteriologists of the United States. Many of these it proved did not make such examinations, and the replies of those who did showed wide variations of procedure on most important points, such as plating, composition of media, incubation temperature, length of incubation, etc.

At the Mexico City meeting in 1906, Prof. H. L. Russell, of the University of Wisconsin, was appointed Chairman of the Committee, but in June, 1907, he asked to be relieved of the Chairmanship, and, by the vote of the Council of the

Laboratory Section, Dr. F. H. Slack, Assistant Director of the Boston Board of Health Laboratory, was appointed Chairman in his stead.

In view of the importance of all bacteriological milk work and the fact that much work yet remains to be done on many important points, this report is offered only as a preliminary statement, and it is hoped that much more will be done along these lines in the near future. On many points the Committee has been unable to accumulate sufficient data to formulate conclusions, and these subjects are left open for further consideration. It is requested that those who differ from the Committee on any points of technique here presented will offer data in support of their views to the Committee.

After much experimental work and careful comparison of the methods in use in various laboratories, the methods given in this report are recommended by the Committee for the present for general use in the bacteriological examination of milk.

F. H. SLACK, *Chairman.*
W. H. PARK.
E. C. LEVY.
F. C. HARRISON.
C. E. MARSHALL.
H. L. RUSSELL.

ACKNOWLEDGMENTS.

The attempt has been made as far as possible to follow along the lines of the admirable work done by the A.P.H.A. Committee on Water Analysis.[1]

Information has been difficult to obtain because so few are working along these lines. Much of the matter obtained has been of a contradictory character. Some who insisted on certain points of technique have failed to respond to the request of the Committee when pressed for data supporting their views.

An earnest endeavor has been made in sifting the material obtained to keep the best methods. To all who have answered our inquiries, whether or not their suggestions have been adopted, to those who have done experimental work and to those who have by their advice and experience aided in the preparation of this report the Committee wishes to express its appreciation and thanks. A list of these is appended.

D. H. Bergey, Philadelphia, Pa.
S. S. Buckley, College Park, Md.
W. M. Campbell, Boston, Mass.
F. R. Eilinger, Rochester, N.Y.
L. W. Fetzer, College Park, Md.
R. G. Freeman, New York, N.Y.
H. A. Harding, Geneva, N.Y.
E. G. Hastings, Madison, Wis.
P. G. Heinemann, Chicago, Ill.
H. W. Hill, Minneapolis, Minn.
H. Moak, Brooklyn, N.Y.
A. P. Norris, Cambridge, Mass.
C E. North, New York, N.Y.
S. C. Prescott, Boston, Mass.
B. R. Rickards, Boston, Mass.
L. A. Rogers, Washington, D.C.
M. J. Rosenau, Washington, D.C.
W. G. Savage, Colchester, Eng.
W. O. Scott, Providence, R.I.
T. Smith, Boston, Mass.
L. P. Sprague, Burlington, Vt.
W. A. Stocking, Ithaca, N.Y.
W. R. Stokes, Baltimore, Md.
B. H. Stone, Burlington, Vt.
A. R. Ward, Berkeley, Cal.
F. P. Wesbrook, Minneapolis, Minn.
C.-E. A. Winslow, Boston, Mass.

NUMERICAL DETERMINATION OF BACTERIA.

There is no method known by which the exact number of bacteria in a sample of milk may be determined, and even when the best methods are used, the count is always less than the actual number of bacteria present, for the following reasons:

(*a*) Many bacteria in process of multiplication are held together by adhesive membranes in pairs, chains or masses. It is for the purpose of separating bacteria thus joined, as well as to obtain an even mixture, that the sample itself and the diluted sample when plating are shaken. This shaking, while it breaks up larger masses and shortens long chains, does not to any great extent break apart the shorter chains, diplococci, etc. Each of these groups of bacteria, when caught in the solid medium, develops as a single colony.

(*b*) It is impossible to obtain a medium suited to the food requirements of all species or races of bacteria.[2]

It has been found by experiment that a medium consisting chiefly of a watery extract of raw meat, alkaline to litmus and slightly acid to phenolphthalein, will furnish the best food for the greatest number.[3]

(*c*) These varying forms of minute vegetable life require varying temperatures for their best development. Many forms which will develop at room temperature will not grow at body temperature. Some require a very high temperature for their best growth.

(*d*) Some bacteria develop in an atmosphere free from oxygen, some only where oxygen is present; many are facultative, growing under either condition. Bacteria which require an oxygen-free atmosphere do not develop in plates as generally prepared. Bacteria requiring oxygen, if deep in the medium, develop but slowly, as they obtain oxygen only by diffusion.

(*e*) Many forms are slow in developing into visible colonies, some requiring three or four days. On the other hand, in plates grown for several days many small colonies are obscured in the growth of larger ones.[4]

(*f*) Each bacterium requires a certain amount of nourishment for development.[5] There are also antagonistic forms which will not develop in close proximity to each other. It therefore follows that in a crowded plate, *i.e.*, over two hundred colonies, many will not develop.[6] This is easily proven by making a higher dilution.

(*g*) Spreaders and molds, by their rapid surface growth, merge with other surface colonies and obscure deeper ones.

(*h*) Samples kept in the collecting case at 34° F. for varying periods have shown a tendency to decrease in the number of bacteria which will develop into colonies.[7] Samples kept in dilution water for several hours have shown a marked de-

crease in the number of bacteria which will develop into colonies.[8]

On account of these reasons strict adherence to standard procedure is of especial importance, since there are so many points where disagreement may result if uniform technique is not followed.

Since at best only approximate results can be reached in the numerical determination of bacteria in milk, and since from the varying methods in use at present counts from different workers are usually incomparable, those methods which have given best results as a whole should be united upon and adopted by all, that a bacterial count on a sample of milk may mean the same if made in any standard laboratory.

COLLECTION OF SAMPLES.

QUANTITY OF MILK REQUIRED FOR ANALYSIS.

The minimum quantity of milk necessary for making an ordinary bacteriological examination is ten cubic centimeters. When making examinations for certified milk, if possible a pint or quart bottle should be taken and brought to the laboratory unopened.

COLLECTING APPARATUS. In collecting milk samples for bacteriological examination it is essential that the sample be taken and kept in such a manner as to prevent either any addition of bacteria from without or multiplication of the bacteria originally present.[9] Bottles, tubes, pipettes, etc., used in the collection of samples, besides being washed, shall be sterilized with dry heat for an hour at or about 160° C., or to the charring point of cotton.

In the selection of "certified milk" samples it is recommended wherever possible that an unopened bottle be taken, placed in a suitably iced case and brought at once to the laboratory.

Samples of "market milk" may be collected as are water samples, in sterile, wide-mouthed, glass-stoppered four-ounce bottles; the case in which they are carried being well iced.[10] The principal difficulty encountered in this method is in transferring the sample from the original container to the bottle, and the various string and wire devices by means of which the bottle is immersed in the original container are objectionable both on account of the labor of preparing such an outfit and also on account of the coating of milk left on the outside of the bottle when the sample has been taken.

An apparatus designed for the use of thirty-two test tubes as containers[11] is recommended as superior to one designed for bottles.

It has been proven that with samples kept properly iced in this particular form of case there is no increase of bacterial content even for twenty-four hours, but rather a slight decrease,[7] the counts varying hardly more than might be expected in duplicate plates. It is recommended, however, that examination of the samples be proceeded with as quickly as possible after the collections are made.

IDENTIFICATION OF SAMPLES. When bottles are used identification numbers should be etched on both bottle and stopper. Test tubes should be labeled or etched[12] and numbered.

A complete record of the samples taken, giving date, time, place, name of party from which sample is taken, name of collector, temperature of milk, character of original container (tank, can, bottle), etc., should be written opposite duplicate numbers in a blank book or pocket card catalogue, or this information may be written on small tags and tied or wired to the corresponding test tube or bottle.

TEMPERATURE. The temperature should be taken immediately *after* taking the sample for analysis, while the milk is still thoroughly mixed.

If it is desired to take the temperature of "certified milk," this should be done when the sample is taken, but from another bottle.

A floating thermometer, graduated to the Fahrenheit scale, is most convenient, and the temperature should be expressed to the nearest degree. It is necessary to standardize the thermometer for at least ten degrees on each side of the legal temperature limit. A quickly registering thermometer should be left at least one minute in the milk and read as soon as removed. A small piece of clean absorbent cotton may be used to wipe the adhering milk from the thermometer that the scale may be easily seen.

REPRESENTATIVE SAMPLES. The collector should always select his own sample, and care should be taken to secure a sample which is truly representative of the milk to be examined.

One of several methods of mixing the milk may be used, comparison having shown the results to be practically the same.[9]

1. Pouring the milk into a sterile receptacle and back.

2. Shaking the milk thoroughly with receptacle turned upside down. (This may be done where the can or bottle is tightly stoppered or capped and is not so full as to prevent thorough agitation.)

3. In open tanks in stores it is allowable to stir thoroughly with the long-handled dipper generally found in use.

4. Where the test tube collecting case is used, thoroughly reliable results are secured by first shaking the can or bottle; and, second, stirring with the large pipette before taking the sample, care being taken to close the upper end of the pipette with the finger so that no milk enters until after the mixing, or the pipette may be emptied after stirring before the sample is taken.

5. For certified milk samples it is recommended that, on arrival at the laboratory, the bottle be opened with aseptic

precautions and the milk thoroughly mixed by pouring back and forth between the original bottle and a sterile bottle. Another method is to mix as thoroughly as possible by agitation for five minutes, then burn through the pasteboard stopper with a hot iron and remove the desired amount of milk with a sterile pipette.[13]

THE INTERVAL BETWEEN COLLECTION AND ANALYSIS.

Generally speaking the shorter the time between the collection and examination of milk samples the more accurate will be the results. For routine work the attempt should be made to plate within four hours of the time of collection.

Too much stress cannot be laid on keeping the samples properly iced during this interval. They should be kept below 40° F., but care should be taken that they are not frozen.

DILUTIONS.

Ordinary potable water, sterilized, may be used for dilutions. Occasionally spore forms are found in such water which resist ordinary autoclave sterilization; in such cases distilled water may be used or the autoclave pressure increased. With dilution water in eight-ounce bottles calibrated for ninety-nine cubic centimeters and in test tubes calibrated for nine cubic centimeters all the necessary dilutions can be made.

Short, wide-mouthed "Blakes" or wide-mouthed French square bottles are more easily handled and more economical of space than other forms of bottles or flasks.[11]

Eight-ounce bottles are the best, as the required amount of dilution water only about half fills them, leaving room for shaking. Long-fiber, non-absorbent cotton should be used for plugs. It is well to use care in selecting cotton for this

purpose to avoid short-fiber or "dusty" cotton, which gives a cloud of lint-like particles on shaking. Bottles and tubes should be filled a little over the 99 c.c. and 9 c.c. marks to allow for loss during sterilization.[14]

The dilutions recommended are 1-10, 1-100, 1-1,000, 1-10,000, 1-100,000 and 1-1,000,000.

For certified milk the 1-10 and 1-100 dilutions should be used, while the 1-10,000 will usually be found best for market milk.

The 1-10 dilution is prepared by shaking the milk sample twenty-five times and then transferring 1 c.c. of the milk to a test tube containing 9 c.c. of sterile water.

The 1-100 dilution is prepared in the same way, except that a bottle with 99 c.c. of sterile water is substituted for the test tube.

The 1-1,000 dilution is prepared by first making the 1-100 dilution, shaking twenty-five times and transferring 1 c.c. of the dilution to a test tube containing 9 c.c. of sterile water.

The 1-10,000, 1-100,000 and 1-1,000,000 dilutions are made in the same manner by dilutions of the 1-100, 1-1,000 and 1-10,000 dilutions, 1 c.c. to 99 c.c. of sterile water.

It is recommended that that dilution be used which will produce about two hundred colonies to a plate, ranging from 40 to 400; where a 1-10 dilution exceeds this number the 1-100 dilution is more accurate, etc. The number of bacteria present may if desired be approximately estimated before dilutions are made by direct microscopic examination of a properly prepared sediment. Otherwise it is necessary to make a range of dilutions, thereafter selecting for record the count obtained on that plate which yields between 40 and 400 colonies.

Plating whole milk is unreliable,[15] whatever quantities be used, since the bacteria are not so well separated as in the dilutions, and often, owing to the crowded conditions, only a portion of the bacteria present will develop into visible

colonies.[6] Moreover, if a cubic centimeter of the milk is used, the turbidity of the jelly, due to the presence of the milk, hides the colonies present from the eye.

MEDIA.

The standard medium for determining the number of bacteria in milk shall for the present be agar, made according to the recommendations of the Committee on Water Analysis,[1] except that the percentage of agar shall be 1 per cent and the reaction +1.5.[2d]

All variations from agar media made as described shall be considered as special media.

Much work yet remains to be done on media; the above is recommended as giving the highest and most uniform counts so far as our comparative work has extended and with but slight variations is the medium in most common use.

STORAGE OF MEDIA. Media may be made up in quantity, tubed and stored (preferably in an ice chamber).

PLATING.

PLATING APPARATUS.[11] For plating it is best to have a single water bath in which to melt the media and a water-jacketed water bath for keeping it at the proper temperature; a wire rack, which should fit both of the water baths, for holding the media tubes; a thermometer for recording the temperature of the water in the water-jacketed bath; sterile 1 c.c. pipettes; sterile petri dishes; and sterile dilution water in measured quantities.

For milk work porous earthenware petri dish covers[16] are much superior to glass covers, since they absorb the excess moisture from the agar and prevent "spreading."

It is quite essential to the best results that the porous covers should be wet as seldom as possible. In sterilizing

them the process should be prolonged over the time necessary to kill the organisms in order that the covers may be thoroughly dry.

Straight-sided 1 c.c. pipettes are more easily handled than those with bulbs; they may be made from ordinary glass tubing about $\frac{3}{16}$ of an inch in diameter and calibrated in the laboratory.[17] They should be made about 10 inches in length.

PLATING TECHNIQUE. The agar after melting should be kept in the water-jacketed water bath between 40° C. and 45° C. for at least fifteen minutes before using, to make sure that the agar itself has reached the temperature of the surrounding water. If used too warm the heat may destroy some of the bacteria or retard their growth.

For routine work in cities in order to bring down the actual number of colonies in a plate around the standard of two hundred, it is well to use a dilution of 1-10,000. To make this dilution use two bottles of sterile water each containing 99 c.c.

Shake the milk sample twenty-five times, then with a sterile pipette remove 1 c.c., put into the first dilution water and rinse the pipette by drawing dilution water to the mark and expelling; this gives a dilution of 1 to 100.

Shake the first dilution twenty-five times, then with a fresh sterile pipette remove 1 c.c., put into the second dilution water, rinsing the pipette to the mark as before; this gives a dilution of 1 to 10,000. Shake the second dilution twenty-five times, then with a sterile pipette remove 1 c.c., and put it into the petri dish, using care to raise the cover only so far as necessary to insert the end of the pipette.

Taking a tube of agar from the water bath, wipe the water from outside the tube with a piece of cloth, remove the plug, pass the mouth of the tube through the flame, and pour the agar into the plate, using the same care as before to avoid exposure of the plate contents to the air.

Carefully and thoroughly mix the agar and diluted milk in the petri dish by a rotary motion, avoiding the formation of air bubbles or slopping the agar, and after allowing the agar to harden for at least fifteen minutes at room temperature place the dish bottom down in the incubator. The practice of mixing the diluted milk with the agar *in the tube*, leaving a certain portion of the bacteria unplated, is not recommended by the Committee.

CONTROLS. Plating should always be checked by controls. A blank plate should be made with each set of milk plates for control of the water, petri dishes, pipettes, etc.

For control on technique of plating it is recommended that for work on "market milk," duplicates be made each day on several plates.

"Certified milk" should always be plated in duplicate, and where possible it is well to have one man's work occasionally checked by another.

Unless duplicate plates show as a rule approximately the same count, the worker should see if there is error in his technique.

Racks are very useful for stacking the plates and to prevent breakage.

Plating should be done always in a place free from dust or currents of air.

In order that the colonies may have sufficient food for proper development, 10 c.c. of agar shall be used for each plate. In plating a large number of samples at one time the dilution and transfer of diluted milk to the plates may be done for four or eight samples, then the agar poured, one tube to each plate, then another eight samples diluted, etc.

INCUBATION.

Concerning incubation two methods are at present in use. Three-fifths of the laboratory workers consulted recom-

mended incubation at 37° C. for twenty-four hours with saturated atmosphere, the remaining two-fifths allowed varying lengths of time at different degrees of room temperature and at whatever degree of humidity happened to obtain.

When considering these two methods many advantages of the method of incubation at 37° C. are evident, including the ease of maintaining this temperature in any laboratory, the evident uniformity of counts so obtained in different places as compared with those obtained by the varying methods of technique, as to temperature and incubation period, where room temperature is employed, and the quickness with which results are obtained, doing away with large accumulations of uncounted plates.

Forty-eight hour plates grown at 37° C. give a slightly higher count,[11] not enough higher to materially change the report, while the loss by "spreaders" is increased and the count delayed.

To secure saturation of the atmosphere the incubator should be made with a shallow depression over the whole bottom surface, which may be kept filled with water, or in default of this a large shallow pan of water may be kept on one of the lower shelves.

Much work will be done on comparison of 37° C. and "room temperature" during the coming year.

COUNTING.

EXPRESSION OF RESULTS. Since minor differences in milk counts are within the working error of the methods and are of no significance in practice, the following scale has been adopted for recording results of market milk examinations:

Counts below 100,000 are distinguished by ten thousands.

Counts between 100,000 and 500,000 are distinguished by fifty thousands.

Counts between 500,000 and 1,000,000 are distinguished by hundred thousands.

Counts between 1,000,000 and 2,000,000 are distinguished by two hundred thousands.

Counts between 2,000,000 and 5,000,000 are distinguished by five hundred thousands.

Counts above 5,000,000 are distinguished by millions.

Therefore only the following figures are used in reporting:

Below	10,000	Above	250,000	Above	1,400,000
Above	10,000	"	300,000	"	1,600,000
"	20,000	"	350,000	"	1,800,000
"	30,000	"	400,000	"	2,000,000
"	40,000	"	450,000	"	2,500,000
"	50,000	"	500,000	"	3,000,000
"	60,000	"	600,000	"	3,500,000
"	70,000	"	700,000	"	4,000,000
"	80,000	"	800,000	"	4,500,000
"	90,000	"	900,000	"	5,000,000
"	100,000	"	1,000,000	"	6,000,000
"	150,000	"	1,200,000	etc., by millions.	
"	200,000				

Counts on "certified" or "inspected" milk shall be expressed as closely as the dilution factor will allow.

The whole number of colonies on the plate shall be counted, the practice of counting a fractional part being resorted to only in case of necessity, such as partial spreading.

Various counting devices have been recommended by different workers. The more simple ones, where the whole plate can be seen at once, are more desirable on account of there being less likelihood of recounting colonies. Colonies too small to be seen with the naked eye or with slight magnification shall not be considered in the count.

EXAMINATION OF CELLULAR CONTENT OF MILK.

Examination of milk sediment reveals certain cellular constituents which when present in abnormal quantities are often regarded as indicating a pathological condition in the animal producing the milk. Microscopical examination of these elements shows a majority of them to be polymorphonuclear cells, and these are generally considered as indicative of suppurative changes.[18]

There seems to be absolutely no relation between the number of these leucocytes in the milk and the general leucocyte content of the blood, thus indicating that a large number of leucocytes in the milk points to a local condition only.[19]

Cattle not infrequently suffer from udder troubles, — gargets of various types in which inflammatory processes of varying degrees of severity may occur. In some cases these may be so slight as apparently not to affect the nature of the milk. Often, however, the milk becomes viscous, sometimes clotty or stringy, and may even be of a bloody nature.

Occasionally such troubles as these develop into a stage in which pus is actually present in such quantities as to be easily recognizable. Milks of this character should of course be excluded from food supplies.

In these cases where a physical examination reveals an abnormal condition, a microscopical study naturally presents a far different picture from that which one obtains in apparently normal milk, and the increase in the number of leucocytes is especially noticeable.

In contrast to these cases where the physical examination and the microscopic findings are in harmony, there are many instances where, although there are an abnormal number of leucocytes present, no physical changes can be demonstrated.

Boards of health have adopted arbitrary standards in a number of instances and rejected supplies with abnormal leucocyte content on the ground that the milk was unwholesome.

Where the numerical standard set is a high one this proceeding must be commended, since there are not lacking unscrupulous people who will put on the market milk from "gargety" cows which cannot be detected by the ordinary chemical tests. The numerical leucocyte test has been the means of detecting such milk, and tracing it back to cows with manifest physical lesions in many instances.[20]

Since, however, evidence already collected warrants, beyond all question, the general statement that these cells frequently do not have the significance that has been attached to them by many observers, it would perhaps be more fair to all parties concerned to use this test at present as a means of detection only, and not condemn the supply unless physical lesions are demonstrated.

We are not prepared at this time to recommend a numerical standard to serve as a basis for such inspection. Milk having a high cell content should, however, be regarded with suspicion.[21] Such milk should be traced to its source and the cow yielding it excluded or kept under close observation if not showing definite physical lesions.

The two methods for the determination of leucocytes in vogue, (1) smeared sediment, (2) volumetric, have each their advocates according to the view point of the worker, and each possesses in its distinctive sphere points of advantage which cannot be ignored. The volumetric method may be further subdivided, some of the methods devised being quantitative only, while others are qualitative as well.

The standards so far chosen have been more or less arbitrarily selected on what appears as rather inadequate data, and from a comparison of results it is apparent that much more comparative work needs to be done.

So much has been published descriptive of these various methods that references only can be given here.[22]

The smeared sediment method has been most used for city inspection work or work of that character where, through examination of many specimens, undesirable sources of supply may be cut off.

Its advantages along this line are:

1. Smallness of sample seized, 10 c.c. being ample for all necessary tests, including bacterial count, leucocyte and streptococci estimations.

2. Rapidity of operation, exact counting being unnecessary in routine work, and as has been proved through thousands of tests, nine out of every ten samples being practically free from suspicion.

3. Since in city inspection work a smear of the sediment is often made and examined for estimation of the number of bacteria present, it is profitable to make both tests at the same time.

4. The operation for many samples is much more simple than the volumetric, and less trying on the eyes.

5. This method has been shown to give consistently lower results than the volumetric.[23] If therefore, for example, 500,000 leucocytes to a c.c. are estimated by this method, it can safely be said that the milk contains greatly in excess of that number, and to that degree is much more suspicious than would be a volumetric determination indicating 500,000.

The volumetric method has been most used for careful research work where exact leucocyte content was to be determined as nearly as possible.

It is hoped during the coming year comparison of volumetric and smeared sediment technique may give us a more exact relation between the two, and that further work by those who have herds at their command may place these examinations upon a more satisfactory basis.

DETERMINATION OF STREPTOCOCCI.[22a]

Although by careful searching a few streptococci will be found in most sediments from pus milk, they are seldom found to any great extent by direct microscopical examination. Occasionally a sample will be found crowded with long chains; more often streptococci, if present, are in the form of diplococci or very short chains.

Where streptococci, diplococci or cocci are found in the sediment and the plate from the same sample contains colonies resembling streptococci colonies, these colonies may be grown in bouillon to see if chains will develop.

First make and record an estimate of the number of such colonies present, then transfer from ten to fifty of them to bouillon and grow for twenty-four hours at 37° C. To examine the bouillon culture spread a loopful on a glass slide, fix with heat, fix with alcohol while slide is still quite hot, stain with methylene blue, wash immediately, dry and examine.

Streptococci in small numbers are present in most market milk as shown by Heinemann, and many of the short-chain varieties are undoubtedly at the time harmless, though by passing through animals their pathogenicity may become marked.[24]

Long-chain streptococci are considered more apt to indicate inflammatory reactions,[25] and milk containing these in large numbers is certainly not a safe article of diet.

A milk should not be condemned because a few chains are found together with large numbers of other microscopic organisms in a bouillon culture, but it is safer to exclude a milk from the market when these three tests agree:

1. Microscopical examination of the sediment shows streptococci, diplococci or cocci.

2. The plate from the same samples shows colonies resembling streptococci colonies exceeding a count of 100,000 to a cubic centimeter.

3. The bouillon culture from these colonies shows long-chain streptococci alone or in great excess as compared with the other bacteria present.

Milk showing in the stained sediment both abundance of long-chain streptococci and high leucocyte content should be condemned as unsafe.

MICROSCOPIC ESTIMATE OF BACTERIA.[26]

A milk sediment properly prepared and examined under the microscope with a one-twelfth oil immersion lens gives a very fair idea as to the number of bacteria present.

It is also fairly easy to determine through the microscopic examination what dilution will be necessary for plating in order to ascertain as correctly as possible the number of bacteria present.

DETECTION OF GAS-PRODUCING ORGANISMS IN MILK.

WISCONSIN CURD TEST.[27] The Wisconsin curd test is conducted as follows:

1. Sterilize milk containers so as to destroy all bacteria in vessels. This step is very important and can be done by heating cans in boiling water or steam for not less than one-half hour.

2. Place about one pint of milk in a covered jar and heat to about 98° F.

3. Add ten drops of commercial rennet extract and mix thoroughly with the milk to quickly coagulate.

4. After coagulation cut curd fine with case knife to facilitate separation of whey; leave curd in whey one-half hour to an hour; then drain off whey at frequent intervals until curd is well matted.

5. Incubate curd at 98° to 102° F. by immersing jar in warm water. Keep jars covered to retain odors.

6. After six to nine hours' incubation open jars and observe odor; examine curds by cutting same with sharp knife and observe texture as to presence of pin holes or gas holes. Observe odor.

7. Very bad milk will betray the presence of gas-producing bacteria by the spongy texture of the curd and will have an off flavor.

8. If more than one sample is tested at the same time, dip knife and thermometer in hot water before each time used.

Milks showing the presence of gas or bad odors in any considerable degree are milks that have been more or less polluted with extraneous organisms or carelessly handled, and as a consequence such milks show a curd filled with small pin holes due to gas. It is not intended that this test should be used for absolute indication of the presence of gas-producing organisms, but rather it has been of service in the detection of the condition of market milk.

OTHER METHODS OF DETECTING GAS-PRODUCING ORGANISMS IN MILK. Gas-producing organisms in milk may be tested for, as in water, with glucose or lactose broth in fermentation tubes. Tests similar to presumptive tests for *B. coli* in water analysis may be made by inoculating into these broth fermentation tubes a c.c. each of the 1-100, 1-1,000 and 1-10,000 dilutions, or if *B. coli* organisms are to be numerically determined the milk may be plated in lactose litmus agar, red colonies counted and species tests worked out. Lactose-bile medium has also been used for the determination of *B. coli* in milk.[28]

The presence of these gas-producing organisms in abundance usually indicates dirty condition of stables, cows or vessels. In small quantities they may be found in most milks.

A rough test[29] is to place five tubes of the milk to be tested at 20° C., 27° C. and 37½° C., observing time and character of the coagulation and the odor.

This test does not require extra apparatus, uses but little milk, does not require rennet and in the hands of one familiar with the fermentation of milk gives good results.

DETERMINATION OF ACIDITY.[30]

While milk is still fresh, *i.e.*, before it has begun to undergo lactic fermentation, it will show an acid reaction which is sometimes expressed in terms of lactic acid. In view of the fact that the acidity of "sweet" milk is due partly to the presence of acid phosphates and partly to dissolved carbonic acid in milk and not to lactic acid, which is probably absent, a better plan is to express the acidity in terms of the number of cubic centimeters of tenth normal alkali necessary to neutralize a given quantity of the milk, either 25 or 50 c.c., using phenolphthalein as an indicator.

If it is desirable to calculate the acidity in terms of lactic acid, multiply the number of cubic centimeters of tenth normal alkali used by 0.897 and divide by the number of cubic centimeters of milk titrated, the result being the percentage of lactic acid. For all practical purposes the factor 0.9 instead of 0.897 may be used. For field work acidity of milk may be measured quite accurately by the alkaline tablet method.[31]

SPECIES.

In the determination of species the Committee refers to the recommendations of the Committee on Water Analysis.[32]

RECORDS.

A card catalogue is far superior to any other method of keeping records.

A series of working cards may be kept in order of the date and duplicates entered in another series in order of the place obtained, thus making it easy to refer to any day's work or to any special dairy.

Cards of different colors may be used to distinguish the different sources, such as samples taken from stores, teams, etc.

The collector may take cards with him and enter details as he takes his samples, or the sample number may be written on the test tube and the details opposite the same number in a notebook, cards being copied from the notebook on return to the laboratory.

STERILIZATION.

DRY STERILIZATION. Petri dishes, pipettes, empty test tubes, etc., are usually sterilized by dry heat.

A common gas-stove oven of large size may be used.

Empty test tubes are sterilized when the heat causes the cotton plugs to turn slightly brown; petri dishes and pipettes should be exposed to the full heat for at least one-half hour, and are best sterilized in dust-proof copper boxes in which they may be kept sterile for a long time.

Such a petri dish box may be made 4½ x 4½ x 10 inches, with a hinged cover on one side closing over the edges and a ring handle on top.

A convenient pipette box is one 11 x 2 x 2 inches, square in section rather than round to prevent rolling, with a ring handle on the end cover.

These boxes must be made without solder, on account of the heat to which they are to be exposed in dry sterilization.

AUTOCLAVE STERILIZATION. Media, dilution water, and the rubber stoppers used in the centrifugal apparatus should be sterilized in the autoclave.

They should be kept under fifteen pounds steam pressure, which gives a temperature of about 250° F. for at least half an hour.

BIBLIOGRAPHY.

1 Transactions, A. P. H. A., Vol. XXX, Part ii.

2 Comparison of Media.

a. Heinemann, Appendix A.

b. Prescott, Appendix B.

c. Prescott, Technology Quarterly, Vol. XVIII, No. 3, page 252.

d. Report Boston Board of Health, 1906, page 74.

3 Fuller and Copeland, Report Massachusetts State Board of Health, 1906, page 585. Muir and Ritchie, 1903, page 37.

4 Slack, Appendix C.

5 Hill and Ellms, Report of Brooklyn Water Supply, 1897.

6 Hill, The Mathematics of the Bacterial Plate Count, Paper read before Laboratory Section A. P. H. A., Sept. 30, 1907.

7 Slack, Appendix D.

8 Slack, Appendix E.

9 Report Boston Board of Health, 1906, page 76.

10 Stokes, Appendix F.

11 Hill and Slack, American Journal of Public Hygiene, November, 1904, page 237.

12 Gorham, Laboratory Course in Bacteriology, page 54.

13 Method used by H. W. Hill, Minnesota State Board of Health Laboratory.

14 Heinemann, Appendix G.

15 Campbell, Appendix H.

16 Hill, Journal Medical Research, Vol. XIII, No. 1 (New Series, Vol. VIII, No. 1), pages 93–96, December, 1904.

17 Gage, Appendix I.

18 Russell and Hoffmann, Journal Infectious Diseases, Supplement No. 3, 1907, pages 63–75.

19 Stone and Sprague, Appendix J.

20 Report of Boston Board of Health, 1905, page 104; 1906, page 112. Greene, Report of New York Milk Conference, 1906, page 24.

21 Sprague, Bulletin No. 4, Vol. VIII, Vermont State Board of Health, June 1, 1907, page 63.

22 *a*. Ward, Henderson, Haring, 19th Biennial Report of California State Board of Health, 1904–06, page 142.

b. Stokes, Annual Report Health Department of Baltimore, 1897, page 105; Journal State Medicine, 1897, page 439.

c. Bergey, Bulletin No. 125, Department Agriculture, Comm. of Pennsylvania.

d. Trommsdorff, R., Munch. med. Woch., 1906, 53, page 541.

e. Bergey, University of Pennsylvania Medical Bulletin, September, 1907.

f. Harris, Journal of Infectious Diseases, Supplement No. 3, May, 1907, page 59.

g. Stewart, American Medicine, Vol. IX, No. 12, page 486.

h. Slack, Journal of Infectious Diseases, Supplement No. 2, February, 1906, page 214.

i. Doane and Buckley, Bulletin No. 102, Maryland Agriculture Expt. Station.

j. Savage, Journal of Hygiene (Cambridge, 1906), No. 2, page 123. Abstract in Expt. Station Record, Vol. XVII, No. 10, page 123.

k. Russell and Hoffmann, Paper read before A. P. H. A. Laboratory Section, Sept. 30, 1907.

l. Russell and Hoffmann, Appendix K.

23 Sprague, Appendix L.

24 Heinemann, Journal of Infectious Diseases, Vol. IV, No. 1, January, 1907, page 87.

25 Andrews and Horder, The Lancet, Sept. 15, 22, 29, 1906.

26 Slack, Technology Quarterly, Vol. XIX, No. 1, March, 1906.

27 Wiley, Foods and Their Adulterations, P. Blackstone & Sons, 1907.

28 Jackson, Determination of Intestinal Bacteria in Milk, Paper read before Laboratory Section A. P. H. A., Sept. 30, 1907.

29 Recommended by Prof. F. C. Harrison.

30 Leach, Food Inspection and Analysis, page 117.

31 Farrington and Woll, Testing Milk and Its Products, page 120.

32 Standard Methods of Water Analysis, page 93.

APPENDIX.

A. HEINEMANN.

Comparison of fourteen samples of milk plated in peptone lactose agar and nutrose lactose agar at 21° C. and 37° C. (owing to lack of space, only averages are given):

AVERAGES.

MEDIUM.	TEMPERATURE.	NUMBER OF DAYS OF INCUBATION.	NUMBER OF BACTERIA PER C.C.
Peptone lactose agar . .	21°	3	3,382,857
Nutrose " " . .	21°	3	3,185,716
Peptone " " . .	37°	1	418,000
" " " . .	37°	2	2,924,000
" " " . .	37°	3	3,002,000
Nutrose " " . .	37°	1	182,000
" " " . .	37°	2	3,245,000
" " " . .	37°	3	3,066,666

B. PRESCOTT.

Comparison of sixty plates on lactose and plain agar. Plain agar made according to Bacteriological Committee on Water, 12 grams to a liter, reaction +1.5. Lactose agar the same with addition of 2 per cent lactose.

On 20 plates, 33⅓ per cent, the count on lactose was greater.
On 17 plates, 28⅓ per cent, the count on plain was greater.
On 16 plates, 26⅔ per cent, the count was alike.
On 7 plates, 11⅔ per cent, one plate was uncountable.

C. SLACK.

Table showing the increase in the number of spreaders as the length of time of incubation is increased and the variation according to the composition of the medium.

One hundred and seventy-four samples, each plated on four different media, making a total of 696 plates. Porous covers used. Plates examined at the end of 24, 48, 72 and 96 hours. Incubation at 37° C.

	24 Hours.				48 Hours.				72 Hours.				96 Hours.			
Media Number	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Percentage of Spreaders .	4½	6	5	4½	8	17½	12	10½	13	24	26	17	16	29½	33½	21
Average per cent of Spreaders	5%				12%				20%				25%			

D. SLACK.

Tests to show whether or not bacteria increase in the test tube collecting case. (The temperature in this case is about 34° F.)

ACTUAL COUNT OF COLONIES 1-10,000 DILUTION.

ORIGINAL COUNT.	AFTER 4 HOURS IN CASE.	ORIGINAL COUNT.	AFTER 7 HOURS IN CASE.
5	2	136	122
0	3	133	152
8	6	146	163
8	8	830*	390*
4	4	122	114
11	8	200	183
274	221	66	74
112	101	97	79
263	200	22	21
18	5	88	103
220	315		
196	143		
650	420		
70	60		
411	305		
275	235		
156	171		
115	159		

* There was evidently some technical error in the plating of this sample.

ORIGINAL COUNT.	AFTER 6 HOURS IN CASE.	ORIGINAL COUNT.	AFTER 4 HOURS IN CASE.	AFTER 24 HOURS IN CASE.
52	43	589	586	578
1178	1016	816	834	633
1363	1084	607	670	703
1216	1075	258	230	291
192	196	895	930	960
93	81	78	66	76
37	24	177	151	123
322	258	83	69	77
298	309	92	133	103
36	39	124	82	95
		2	1	1

Since the variations are hardly more than might be expected in duplicate plates made at the same time, we conclude there is not only no increase in the number of bacteria between time of collection and plating, but usually a slight decrease.

E. SLACK.

Tests to show whether or not bacteria increase while dilutions are being made and ultimate fate of milk bacteria in water.

ORIGINAL COUNT.	AFTER 15 MIN. IN DILUTION AT ROOM TEMPERATURE.	ORIGINAL COUNT.	AFTER 4 HOURS IN DILUTION AT ROOM TEMPERATURE.	AFTER 24 HOURS IN DILUTION AT ROOM TEMPERATURE.
54	40	150	28	Est. 1000
2	1	415	147	Innumerable
3	0	1085	133	Innumerable
5	15	655	92	Innumerable
315	347	Est. 2400	680	Innumerable
143	117	257	115	Est. 1100
60	56	Est. 1500	202	17
137	135	Est. 1200	311	Innumerable
73	71	Est. 1200	369	Innumerable
100	87			
25	10			
101	102			
132	143			
59	59			
66	61			
3	3			
158	147			

ORIGINAL COUNT.	AFTER 6 HOURS IN DILUTION AT ROOM TEMPERATURE.	AFTER 28 HOURS IN DILUTION AT ROOM TEMPERATURE.
10	8	Innumerable
11	8	Innumerable
6	3	Innumerable
20	1	18
562	102	160
6	0	63
9	7	Innumerable
0	0	1
80	2	10
93	12	Est. 600
102	10	112
0	1	0
1	3	0

From these experiments we are led to conclude that during the few minutes the milk is in the dilution water there is no increase in the number of bacteria. On the contrary, for the first few hours there is usually a marked decrease which sometimes persists, but usually forms are present which eventually multiply exceedingly.

F. STOKES.

Stokes recommends a copper box holding twelve two-ounce sterilized glass cologne bottles, etched with diamond ink for labeling. These bottles are held in flat tin holders, having intervals between each series of four in which ice can be placed. Each bottle has wire attached wrapped around the neck and the stopper. This can be pulled out so that the bottle can be slipped in each milk can without contaminating the cans from ladles slipped in other cans, or by the fingers of the inspector. Bacteriological and chemical tests are carried out with these samples.

G. HEINEMANN.

Recommends as the result of repeated measurements filling dilution bottles to 100 c.c.; approximately 99 c.c. remaining after sterilization.

H. CAMPBELL.

Tests comparing the plating of 1-20 c.c. of whole milk with the ordinary dilution methods.

TESTS COMPARING THE PLATING OF 1-20 C.C. OF WHOLE MILK WITH THE ORDINARY DILUTION METHODS.

1-20 c.c. Whole Milk.		Dilution 1-20.		Dilution 1-100.	
Number of Colonies.	Count.	Number of Colonies.	Count.	Number of Colonies.	Count.
712	14,240	1,109	22,180	401	40,100
688	13,760	1,042	20,840	365	36,500
181	3,620	257	5,140	98	9,800
173	3,460	229	4,580	87	8,700
660	13,200	870	17,400	220	22,000
720	14,400	680	13,600	200	20,000
185	3,700	415	8,300	141	14,100
616	12,320	1,030	20,600	331	33,100
202	4,040	210	4,200	49	4,900
200	4,000	237	4,740	128	12,800
232	4,640	129	2,580	71	7,100
340	6,800	.....	.....	224	22,400
449	8,980	.....	.....	217	21,700
128	2,560	200	4,000	.....	.....
110	2,200	240	4,800	.....	.....
118	2,360	128	2,560	.....	.....
96	1,920	140	2,800	.....	.....

I. GAGE.

A calibrating device copied from one in use by S. DeM. Gage of the Lawrence Experiment Station is convenient. By means of a three-way stopcock, mercury, from a reservoir, is filled into the tube to be calibrated, then a c.c. by weight is withdrawn and the tube marked. The whole system is first filled with mercury, care being taken to expel all air from the escape tube. The pipette to be calibrated is inserted, small end up, and filled with mercury from the supply tube until a drop stands on top; the flow is then stopped and the drop of mercury on top of the tube brushed off with the finger. Exactly 13.6 grams (1 c.c.) of mercury are then allowed to escape into the pan on the balances, the pipette is marked at the place where the mercury then stands with

hydrofluoric acid, then the remainder of the mercury in the pipette is run into the pan on the balances, the flow stopped and a new pipette inserted, the mercury in the pan poured back into the reservoir and the operation repeated.

Instead of weighing the mercury each time, it may be run as suggested by Wesbrook into an accurately graduated 1 c.c. receptacle. By rubbing the pipettes before calibration, while hot, upon a paraffin block, they may be coated at about the point where the mark will come. A ring cut through the paraffin at this point is filled with hydrofluoric acid for five minutes and leaves a fine cut mark.

J. STONE AND SPRAGUE.

Blood taken from ear at the time milk sample was secured. Blood count made with Thoma Zeiss counter. Milk counted by Doane-Buckley method. (Owing to lack of space details are omitted.)

Of the 58 cows examined there were 12, or 20 per cent, which showed a milk leucocyte count of over 500,000; 5, or 8½ per cent, with a milk count of over 1,000,000; and there were 7, or 12 per cent, with a blood count of over 10,000 leucocytes per m.m., and 1, or 2 per cent, with a blood count of over 20,000. The number with a low blood count (under 6,000) was 20, or 34 per cent.

The number having both a high blood and milk count was nil, and the number with a low blood count and a high milk count was 6, 10 per cent of the whole number, and 50 per cent of the number showing high milk count.

There seems to be absolutely no relation between the number of leucocytes in the milk and the general leucocyte content of the blood, thus indicating that a large number of leucocytes in the milk points to a local condition, if of any consequence at all.

That a high leucocyte count in either blood or milk is a comparatively constant factor is indicated, since in nearly

every case second and third counts correspond very closely with the first.

K. RUSSELL AND HOFFMANN.

Modification of Doane-Buckley method for estimation of leucocytes.

COLLECTION OF SAMPLE.

Sample for analysis should be taken from the entire milking of the animal, as the strippings contain a somewhat larger number of cells than other portions of the milk. For the purpose of examination take 200 c.c in stoppered bottle.

TIME INTERVAL BETWEEN COLLECTION AND ANALYSIS.

To secure satisfactory results, milk must be examined in a sweet condition. Development of acidity tends to precipitate casein in the milk, and thus obscure the examination of microscopical preparations. Samples received from a distance can be preserved for satisfactory microscopical examination by the addition of formalin at time of collection — proportion of 1 c.c. to 250 c.c. of milk. Formalin has been found the best preservative to use, although it causes contraction of the cells to some extent.

PROCEDURE WITH REFERENCE TO PREPARATION OF SAMPLE.

1. HEATING SAMPLE.

To secure the complete sedimentation of the cellular elements in the milk, it is necessary to heat the same to a temperature which will break down the fat globule clusters, or lessen the ordinary creaming properties of the milk. Samples should be heated at 65° to 70° C. for not less than ten

minutes, or from 80° to 85° where very short periods of exposure (one minute) are given. This treatment causes the more homogeneous distribution of the fat globules through the milk, and when the sample is then subjected to centrifugal force the cell elements are not caught in the rising fat globules, but on account of their higher specific gravity are concentrated in the sediment by centrifugal force.

2. CONCENTRATION OF CELLULAR ELEMENTS.

Ten c.c. of milk are placed in an ordinary sedimentation tube, and after heating as above directed, and subsequently shaking, the milk is centrifugalized twenty minutes at 1,200 revolutions per minute. A hand centrifuge may be employed for this purpose, but where available a steam turbine Babcock milk tester may be found more practicable.

NOTE. — This speed, maintained for the time mentioned, is sufficient to sediment practically all the cell elements suspended in the milk. In our experience we have found the number of cells in supernatant milk to average only 3½ per cent.

3. PREPARING THE SAMPLE FOR EXAMINATION.

After centrifugalizing, the cream and the supernatant milk are removed, with the exception of the last half c.c., by aspirating with an exhaust pump and wiping the walls of the tube with a cotton swab. After thoroughly mixing the sediment with a glass rod, enough of the emulsion is placed in an ordinary blood counter (Thoma Zeiss pattern) to fill exactly the cell. The preparation is then allowed to stand for a minute or two to permit the cellular elements to settle to the bottom of the cell, while the few fat globules in the liquid rise to the surface. This method permits of the differentiation of the cells from the small fat globules, so that a distinct microscopic observation can be made.

EXAMINATION OF MATERIAL.

The preparation is examined in an unstained condition.

NOTE. — Most observers have usually stained the sediment prior to examination, but we have found with the above treatment that the cells may be enumerated quite as well in an unstained as a stained condition.

The count is made with a 1-inch eyepiece and $\frac{1}{6}$ objective. Where the number of cell elements exceeds 12 or 15 per microscopic field, above referred to, one-fourth of the entire ruled area of the counter, equivalent to 100 of the smallest squares of the cell, are counted. Where the cell elements are less abundant, one-half of the cells in the entire area (two to four hundred squares) are enumerated. The average number of the cells per smallest square is then obtained, which, when multiplied by 200,000, gives the number of cells per cubic centimeter in the original milk. (If multiplied by 4,000,000, we have the number of cells per cubic centimeter in the sediment examined. As the sediment represents the concentration of the cells into one-twentieth of the original volume of milk taken, 10 c.c. to one-half c.c., this number should be divided by 20 to give the number of cells per cubic centimeter in the original milk.)

NOTE. — The above factor of 4,000,000 is obtained as follows: The cubic content of the blood counter represents one-tenth of a cubic centimeter. This volume is divided by means of the ruled scale into 400 small cubes, each equal to one four-thousandth of a cubic millimeter, or one four-millionth of a cubic centimeter.

EXPRESSION OF RESULTS.

All results should be expressed in numbers of cells per cubic centimeter of the original milk, and in order to avoid fictitious accuracy, should be given in accordance with the method adopted by the Committee on Standard Methods of Water Analysis, as reported in this Committee's report

to the Laboratory Section of the American Public Health Association for 1905, page 94.

L. SPRAGUE.

Comparison of Doane-Buckley and Hill-Slack (modification of Stewart's) methods of estimation of leucocytes:

COW.	HILL-SLACK METHOD.	DOANE-BUCKLEY METHOD.
1	252,827	580,000
2	241,100	485,000
3	548,900	875,000
4	252,800	595,000
5	199,600	510,000
6	249,500	985,000
7	282,700	899,000
8	332,600	570,000
9	532,200	640,000
10	153,000	846,000

PRESERVATIVES IN FOOD AND THE EFFECT THEREOF ON THE PUBLIC HEALTH*

By DR. H. W. WILEY
Washington, D.C.

It is well known that there is a wide difference of opinion among experts respecting the effect of certain chemicals added to foods as preservatives upon health. As is natural in such cases, there are two sides to the question, and it is attacked constantly from two points of view. The medical officer of health naturally looks at the use of preservatives solely from the effect which they have upon health; the manufacturer of food products looks at the use of preservatives solely from its relation to manufacture and trade. There is a third point of view which should be occupied by experts who look at the subject from a purely scientific point of view, that is, men who are not interested officially in conserving the public health, nor in any commercial way, in manufacturing. It is not meant in this paper that because a man is interested professionally in one side of a question, he fails to see the merits of all sides, nor is it maintained that the unbiased expert is any more able than either of the others to discuss the subject. The only contention in this case is that the report of the unbiased expert is likely to have more weight with the community, or with the court, than the testimony of the other experts, conceding that they all have

* Read before the Laboratory Section, American Public Health Association, at Atlantic City, September 30, 1907.

equal merit. That experts should honestly arrive at opposite conclusions is not any matter of astonishment. The methods of conducting the investigation, the subjects on which the experiment is conducted and the points which are kept principally in view, the time over which the investigation is conducted, the quantities of the materials experimented with, all have their effect. The particular experimental work which is set forth in this paper was undertaken to show that a certain beverage, namely, cider, which is very commonly preserved in this country by the addition of benzoate of soda, might be manufactured of a better and superior quality, and kept without the addition of any preservative whatever. The work was conducted under my instructions in Nebraska, by one of my assistants, Mr. H. C. Gore. A detailed account of the experimental work is contained in his report, in which it is shown that, by the selection of the proper kind of fruit, by care in the crushing of the fruit and the expression of the juice, by passing the juice twice through a cream separator, and by sterilization, cider of extraordinary good quality was secured which, when enclosed in sealed cans, keeps indefinitely. It is also shown that it keeps for a very long time in barrels and other wooden containers, and, therefore, that the claims made by the manufacturers of this line of goods that cider cannot be made without the use of a preservative are baseless. As an addendum to this work, statistics are given of the opinions of experts on the advisability of using preservatives in foods.

In order to obtain the views of eminent physiologists and hygienists, health officers and physicians in the United States as to the propriety of using preservatives in foods, a list of questions was sent out from the Department of Agriculture, to which a large number of replies was received. These questions and the replies have been tabulated as follows:

1. Are preservatives, other than the usual condimental

preservatives, namely, sugar, salt, alcohol, vinegar, spices and wood smoke, injurious to health?

Affirmative	218
Negative	33
Total	251

2. Does the introduction of any of the preservatives which you deem injurious to health render the foods injurious to health?

Affirmative	222
Negative	29
Total	251

3. If a substance added to food is injurious to health, does it become so when a certain quantity is present only, or is it so in any quantity whatever?

Affirmative	169
Negative	79
Total	248

4. If a substance is injurious to health, is there any special limit to the quantity which may be used which may be fixed by regulation or by law?

Affirmative	68
Negative	183
Total	251

5. If foods can be perfectly preserved without the addition of chemical preservatives, is their addition ever advisable?

Affirmative	12
Negative	247
Total	259

It can be readily seen from this tabulation that the opinions expressed point overwhelmingly to the fact that preservatives

as a class are injurious to health, and hence their use is, under the act, inhibited.

Other data are also given showing that the very commonly expressed opinion among manufacturers that chemical preservatives are a necessity to the trade is recognized. The relation of this investigation to the public health is patent. It is not claimed that chemical preservatives in any case are food products. If they take any part in metabolism, their influence is to disturb the normal processes unfavorably. They place upon the excretory organs an additional burden. Benzoic acid or benzoate of soda, the preservative specifically mentioned, is changed in the metabolic process principally into hippuric acid, thus adding an additional destructive product to the fluids of the body, the elimination of which is at once required to avoid the poisonous effects which it otherwise would produce. The trend of the argument is to show, therefore, that chemical preservatives have no place in food products.

REPORT OF THE COMMITTEE ON STANDARD METHODS OF WATER ANALYSIS, 1907

A Committee on Standard Methods of Water Analysis was appointed at the meeting of the Laboratory Section of the American Public Health Association at Minneapolis in 1899. As a result of the appointment of that Committee an elaborate report on standard methods of water analysis was made at a meeting of the section at Havana in January, 1905, and this report was published in the *Journal of Infectious Diseases*, Supplement No. 1, May, 1905, and reprints of this report bound for distribution.

It was attempted in that report to give in full such methods of physical, chemical and bacteriological examination of water as at that time met the approval of the Committee, were used in up-to-date laboratories, and could be recommended for general use. Since the publication of that report, three years ago, no attempt has been made by the Committee to again report at any length upon this subject, and the Committee as now formed does not believe that it is either desirable or feasible to make any extended report at the present time. It believes that such reports as that of 1905 enter so elaborately into all details of sanitary water analysis that taken as a whole they should stand for a number of years, probably for five years at least.

The Committee recognizes the fact that new methods of both chemical and bacterial analysis and improvements upon older methods are being constantly proposed and practised, but the Committee believes that such new methods or improvements of older methods should not be incorporated into a report upon standard methods until after a season of trial in many laboratories. The Committee also recognizes

that methods of analysis, useful and of some value in some laboratories, are of less value in others, owing to local conditions, the class of waters to be examined, etc. At the present time, therefore, it is not proposed to make anything in the nature of a new report, but simply to suggest such work in various laboratories as will be of help to the Committee when the time arrives for a new report to be submitted and published. At the present time few changes of or additions to the chemical methods presented in the report of 1904 have been suggested to the Committee, and such as have been suggested need, in the opinion of the Committee, a thorough trying out. It should be the aim of laboratory workers, as well as of the Committee, to investigate and approve methods that are an actual improvement over older methods, and not simply different from these older and standard methods. If the new methods are intended to save laborious laboratory work and yet accomplish as good results, both labor saving and accuracy should be proved before the methods are adopted.

It is suggested that it may be necessary for this Committee to formulate methods for the interpretation of water analysis, but it is doubtful in the minds of some of the Committee whether such a procedure is necessary.

The following chemical methods are perhaps worthy of study at the present time:

The so-called Brucine method for the determination of nitrates.

The determination, by the so-called methylene blue test, of the stability or non-putrescibility of the effluents of sewage filters.

Studies of the value of the various methods for the so-called oxygen consumed determination.

The practicability of direct nesslerization for the determination of free ammonia, and for the direct reading method for Kjeldahl nitrogen.

Some of these methods when tried in certain laboratories, during the past few years, have been pronounced of little value, while in other laboratories a different estimation of some or all of them is held. Before any of these methods of analysis are deemed worthy of being incorporated in a report upon standard methods, however, many laboratories should be heard from in regard to them.

In bacterial work it is suggested that a standard method for the determination of the colon bacillus should be formulated, and it is proposed that certain features of the usual method be modified as follows:

a. By omitting the determinations of motility.

b. By omitting tests for coagulation of milk when cultures have been isolated by lactose agar plates.

c. By omitting determinations of the amount of gas formed and the gas ratio in either presumptive or confirmatory tests.

d. By allowing the use of bile broth as an alternative for Smith's solution or pepton dextrose broth.

It is also suggested that agar be substituted for gelatin as the standard medium for the determination of numbers of bacteria, and in this connection it is believed by some that counts of bacteria should be made on plates incubated at at least two different temperatures.

It is also suggested that the Committee should consider the formulation of some standard method for the determination of streptococci, for enteritidis sporogenes and for *S. choleræ*.

During the coming year, therefore, the Committee, if continued, proposes to secure in various laboratories special investigations of the points mentioned, and will report in regard to these investigations, etc., at the next annual meeting.

Respectfully submitted,

H. W. CLARK,

Chairman, for the Committee.

REPORT OF COMMITTEE ON TECHNICAL PROGRESS*

Gentlemen: Your Committee on Technical Progress is a standing committee under the constitution of the Laboratory Section, consisting of the chairmen of the various Technical Committees, presided over by the Chairman of the Section. This Committee, to quote the constitution, is responsible for "the scientific work and development of the Section."

At the Havana meeting of the Section, the Technical Committees, then several in number, were cut down to two, and have never since been increased in number. It happens, therefore, that this year, the Chairman of the Water Committee and the Chairman of the Milk Committee form, with the Chairman of the Section, the total membership of the Committee on Technical Progress. Furthermore, because no report has ever heretofore been made by the Committee on Technical Progress, this report is its first.

The writers of the Section constitution had in mind that in most scientific societies every attention is paid to parliamentary organization, but very little to the organization of that which forms the main reason for the existence of such societies, the progress of the particular science or art in question. The attempt was made to provide, in this Section, an organization as complete for its purely scientific side as for its administration.

Your Committee, notwithstanding the absence of precedents for its action, has undertaken to make the following report, reviewing briefly the history of the Technical Com-

* Read before the Laboratory Section, American Public Health Association, at Atlantic City, September 30, 1907.

mittees of the Section to date, and making certain recommendations, with the hope that the Section will accept them as a basis of discussion.

The Laboratory Section was organized in 1899, primarily as the outcome of the success which greeted the efforts of the well-known Committee on Standard Methods of Water Analysis of the General Association. That Committee became a Technical Committee of the Section and continues as such today. Committees on various other subjects were from time to time appointed, but heretofore but small progress has been made, especially since the Havana meeting, when the existing committees were nearly all abolished. Since that time only the Milk Committee has been newly appointed.

RECOMMENDATIONS.

Your Committee believes that the results achieved by the Committee on Standard Methods of Water Analysis justify the Section in continuing its own policy, as exemplified in the appointment two years ago of a Committee on Standard Methods of Milk Analysis, and recommends the appointment of Committees on Standard Methods for the various public health services, and would specify, as called for, a Committee on Standard Methods of Diphtheria Diagnosis, of Typhoid Diagnosis, of Glanders Diagnosis, of Rabies Diagnosis, of Sputum Examination, Syphilis Diagnosis, Gonorrhœal Diagnosis, of Sewage Analysis, of Air Analysis, on Standard Methods of making vaccine, antitoxin, mallein, tuberculin, etc., all as applied to public health work, and also on Mailing Infectious Material and the examination of Embalmers' Fluids.

Your Committee feels that the work of these Technical Committees of the Section should not cease with the standardization of methods; methods should be as uniform, exact

and rapid as may be compatible with obtaining the results desired. But the termination of the analysts' work and the announcement of the technical result is but the initiation of the course which that result must run before its true value has materialized. It is very much indeed to obtain a certain analytic result quickly, accurately and by methods applicable to the examination of large numbers of specimens. The most refined results, however, are no better than the most crude, or than none at all, if their meaning is not made known also. It is usually assumed that those capable of securing the technical results must know what those results mean, a totally unwarranted assumption. As the expert telegrapher need not, often cannot, even guess at the significance of a message he transmits, so the analyst need not, often does not, know what his results mean, chiefly because they can seldom be interpreted directly, but generally require other data, not analytical, in conjunction with which they alone become valuable. Interpretation of results should be attacked by your Committee, we believe. As the standardization of methods was at one time believed to be a hopeless task, but is now an accomplished and accepted fact, so also we believe the interpretation of results, an even wider and more complicated field, should be, and with earnest effort will ultimately be, formularized and established.

Your Committee would also suggest that the plan heretofore usually followed, whereby the appointing of Technical Committees by the Council is done without consultation of those appointed, be modified in such a manner that the committees to be appointed may be known beforehand, and members who may wish to serve on such committees be asked to state their preferences. The efficiency of a member of a Technical Committee is usually dependent upon the trend of his own work during the time he is a member; the fact that a Section member has already become well known in relation to a given subject is not a guaranty of efficiency

upon a committee dealing with that subject, for his work and interests at the time of appointment on the committee may be in a quite different direction.

H. W. HILL, *Chairman* (*ex officio*).
F. H. SLACK.

(Mr. H. W. Clark, the third member was not present.)

[EDITOR'S NOTE. — The Laboratory Section, in session at Atlantic City, Sept. 30, 1907, accepted this report and went into committee of the whole to discuss it. As a result, the Section voted that the Council of the Section should undertake the carrying out of the recommendations made, prepare a list of committees, secure an expression from each member of the Section as to his preferences, and, on the basis of these returns, appoint the committees.]

TECHNICAL COMMITTEES OF THE LABORATORY SECTION, A.P.H.A.

By vote of the Council of the Laboratory Section, the following committees have been appointed:

Committee on Standard Methods of Bacterial Water and Sewage Analysis, D. D. JACKSON, Mount Prospect Laboratory, Brooklyn, N.Y., Chairman.

Committee on Standard Methods of Chemical Milk Analysis, PROF. J. O. JORDAN, 30 Huntington Avenue, Boston, Mass., Chairman.

Committee on Standard Methods for the Bacterial Diagnosis of Diphtheria, MR. B. R. RICKARDS, 739 Boylston Street, Boston, Chairman.

Committee on Standard Methods for the Bacterial Diagnosis of Typhoid, DR. F. F. WESBROOK, University of Minnesota, Minneapolis, Minn., Chairman.

Committee on Standard Methods for the Bacterial Diagnosis of Tuberculosis, DR. M. P. RAVENEL, University of Wisconsin, Madison, Wis., Chairman.

Committee on Standard Methods for the Analysis of Air, PROF. C.-E. A. WINSLOW, Massachusetts Institute of Techonology, Boston, Chairman.

Committee on Standard Methods for the Diagnosis of Rabies, DR. ANNA WILLIAMS, Research Laboratory, East 16th Street, New York City, Chairman.

Committee on Standard Methods for the Bacterial Diagnosis of Glanders, DR. W. L. BEEBE, St. Anthony's Park, Minn., Chairman.

Committee on Standard Methods of Preparing Diphtheria Antitoxin, DR. H. D. PEASE, State Antitoxin Laboratory, Albany, N.Y., Chairman.

Committee on Standard Methods of Preparing Smallpox Vaccine, DR. J. H. HUDDLESTON, 126 West 85th Street, New York City, Chairman.

Committee on Standard Methods for the Preparation of Tuberculin and Mallein, DR. V. A. MOORE, Cornell University, Ithaca, N.Y., Chairman.

OTHER COMMITTEES

Committee on Mailing Infectious Material, DR. M. L. PRICE, Secretary State Board of Health, Baltimore, Md., Chairman.

Committee on Standard Methods for the Bacterial Diagnosis of Syphilis, DR. H. U. WILLIAMS, University of Buffalo, Buffalo, N.Y., Chairman.

COMMITTEES PREVIOUSLY ESTABLISHED

Committee on Standard Methods of Chemical Water and Sewage Analysis, PROF. E. B. PHELPS, Massachusetts Institute of Technology, Boston, Chairman.

Committee on Standard Methods for the Bacterial Analysis of Milk, DR. F. H. SLACK, 739 Boylston Street, Boston, Chairman.

The committees just appointed will be expected to plan their work for the coming year and to furnish the Section with a short report of such plans at the coming meeting in August. The Chairmen are referred to Section 30 of the Constitution (Transactions, Vol. XXXI, Part II, page 254) for information relating to the addition of advisory members to their committees, and also to Sections 28 and 29 for other information for their guidance.

B. R. RICKARDS, *Secretary*,
For the Council, Laboratory Section.

THE ANTISEPTIC AND GERMICIDAL PROPERTIES OF SOLUTIONS OF FORMALDEHYDE AND THEIR ACTION UPON TOXINS *

By JOHN F. ANDERSON

From Hygienic Laboratory, Public Health and Marine-Hospital Service

Since the discovery by Loew and Fischer, in 1886, of the germicidal action of formic aldehyde a large amount of work has been done with the substance both as a gas evolved by various means and in the watery solution.

The recent work by McClintic seems to have established its limitations when used as a gas. The great variation in the results of various workers in regard to its action as a germicide and antiseptic in its watery solution has led me to try to determine its real value. The need of an efficient and, at the same time, a safe and comparatively cheap disinfectant is great, especially for the disinfection of the excreta of persons sick with infectious diseases. For this purpose the agent should be rapid in its action, an efficient deodorant, comparatively cheap and safe to handle. Formic aldehyde in solution, in my opinion, comes nearer to fulfilling these conditions than any other agent we have at the present time.

In the minds of the laity a deodorant is more or less synonymous with a germicide, but, of course, a deodorant may be almost valueless as a disinfectant, and, on the other

* Abstract of paper read before the Laboratory Section, American Public Health Association, at Atlantic City, September 30, 1907.

hand, a disinfectant may possess but slight deodorizing properties. In the use of an agent for the disinfection of excreta, etc., it is important that the person using it understands just what is meant when told to disinfect the discharge with a five per cent solution. It may be understood that a five per cent solution of the agent is to be added to the discharge, while what is really meant is that the agent shall be in the proportion of 5 parts in 100 of the total volume under treatment. Of course it is needless to say that there must be a thorough mixture of the agent and of the material to be disinfected, and that they must remain in contact a sufficient length of time for the maximum action of the germicide to be exerted. While, for example, a 2 per cent solution might kill typhoid bacilli in 30 minutes, it might take a 1 per cent solution an hour or longer.

A number of samples of different solutions of formic aldehyde were analyzed to determine the exact percentage of the aldehyde contained therein, and quite a variation in the percentage was noted. The highest was 52 per cent, which was in a sample sent by a manufacturer, but it soon decreased to 43; the lowest was 29 per cent.

Bernard Smith examined 29 samples, and the lowest percentage he found was 32.45 per cent and the highest 39.11 per cent, the average of the 29 samples being approximately 37 per cent. My work was done with solutions varying from 37.2 per cent to 37.4 per cent, and will be discussed in percentages of formalin, the name by which the watery solution is best known, of about 37.2 per cent formic aldehyde.

ORIGINAL WORK

ANTISEPTIC POWER OF FORMALIN. A series of experiments was made to determine the amount of formalin

necessary to restrain the development of bacteria and molds in stable manure, garden earth, etc. For this purpose nutrient broth was placed in sterile flasks and formalin added in proportions of 1 to 7,000 down to 1 to 500. The broth was then inoculated with the various materials, kept at room temperature, and observed for fourteen days.

It was found that in the flask to which garden earth was added that bacterial growth ceased in the dilution of 1 to 5,000, and mold developed on the seventh day in the dilution of 1 to 1,000.

In the flask to which stable manure was added bacterial growth occurred in the dilution of 1 to 4,000, and mold on the seventh day in 1 to 1,000.

In the flask to which were added bits of hay bacterial growths occurred in a dilution of 1 to 4,000, and mold on the fourth day in a dilution of 1 to 1,000.

It will be seen that the lowest dilution in which bacterial growth occurred was 1 to 4,000, and molds in 1 to 1,000.

ANTISEPTIC POWER AGAINST PURE CULTURES. The above experiment having been made to determine its restraining influence for putrefactive changes, another series was made to determine its antiseptic action against pure cultures of bacteria.

For this purpose bouillon containing various proportions of formalin was distributed in sterile test tubes and each tube was then inoculated with a small loopful of a 48-hour agar culture of the particular organism, placed in the incubator at 37 degrees C., and observed daily for 15 days. The formalin used contained 37.2 per cent formic aldehyde.

The results are shown in the following table:

TABLE I.

SUMMARY SHOWING LOWEST DILUTION IN WHICH ALL GROWTH WAS RESTRAINED

ORGANISM	Dilution in which All Growth Was Restrained
Staphylococcus epidermidis albus	1 to 4,000
Staphylococcus pyogenes albus	1 to 3,000
Staphylococcus pyogenes aureus	1 to 3,000
Staphylococcus pyogenes citreus	1 to 3,000
Bacillus typhosus	1 to 3,000
Bacillus coli communis	1 to 3,000
Bacillus dysenteriæ (Shiga)	1 to 4,000
Bacillus pyocyaneus	1 to 3,000
Bacillus choleræ	1 to 6,000
Bacillus diphtheriæ	1 to 5,000
Bacillus mallei	1 to 6,000
Bacillus anthracis	1 to 4,000
Bacillus pestis	1 to 5,000
Bacillus megatherium	1 to 6,000
Bacillus subtilis	1 to 3,000
Bacillus prodigiosus	1 to 3,000
Bacillus acidi lactici	1 to 6,000
Bacillus proteus	1 to 6,000
Bacillus enteritidis	1 to 3,000

From the above it will be seen that many of the organisms used grew in dilutions as low as 1 to 4,000; a few were restrained in a dilution of 1 to 6,000; none grew in a stronger solution than 1 to 3,000.

GERMICIDAL POWER OF FORMALIN. The germicidal power of formalin in various strengths was studied on pure cultures, human fæces and sputum. The growth in broth tubes was principally used. Agar plates were also made at corresponding intervals in order to determine when the maximum effect of formalin is exerted.

GERMICIDAL POWER AGAINST PURE CULTURE. The germicidal power of formalin was determined in 1, 2, 3, 5 and 10 per cent dilutions against the principal pathogenic

organisms. The following method was observed in each case: For a 5 per cent strength 94 c.c. of sterile water was placed in a sterile flask and 1 c.c. of a heavy emulsion freed from clumps, of a 48-hour slant agar culture of the organism being studied, was added; then 5 c.c. of formalin was added to the entire contents of the flask and well shaken. One loopful at 10-minute intervals up to one hour was planted in a full tube of nutrient bouillon and the growth noted from day to day.

The experiments were repeated in each dilution so as to check any irregularities that might occur.

The results of the experiments, summarized, show that 1 per cent formalin containing 37.2 per cent aldehyde killed the vibrio of cholera in 10 minutes, *B. coli* in 90 minutes, *B. diphtheriæ* in 20 minutes, *B. mallei* in 10 minutes, *B. pyocyaneus* in 40 minutes, *B. dysenteriæ* and *Staphylococcus albus* grew up to 2 hours, and *Staphylococcus pyogenes aureus* and *B. typhosus* were killed in 90 minutes.

Two per cent formalin (containing 37.2 per cent aldehyde) killed *B. coli* after 60 minutes' exposure, *B. diphtheriæ* after 10 minutes, *B. pyocyaneus*, 10 minutes, *B. dysenteriæ*, 60 minutes, *Staphylococcus pyogenes albus*, 60 minutes, and *Staphylococcus pyogenes aureus* and *B. typhosus* after 40 minutes.

Three per cent formalin (containing 37.2 per cent aldehyde) killed *B. coli* after 30 minutes' exposure, *B. dysenteriæ*, 40 minutes, *Staphylococcus pyogenes albus*, 30 minutes, *Staphylococcus pyogenes aureus*, 20 minutes, and *B. typhosus* after 20 minutes.

Five per cent formalin (containing 37.2 per cent aldehyde) killed *B. coli* and *Staphylococcus pyogenes albus* after 30 minutes' exposure, *B. dysenteriæ* after 40 minutes, *Staphylococcus pyogenes aureus* and *B. typhosus* after 20 minutes.

Ten per cent formalin (containing 37.2 per cent aldehyde) killed all the non-spore-bearing organisms tested in less than

10 minutes, except *B. dysenteriæ* and *Staphylococcus pyogenes aureus*, which were killed after 10 minutes.

TIME OF MAXIMUM GERMICIDAL EFFECT. In order to study when the greatest germicidal action is exerted, pure cultures of the five most resistant organisms were exposed to a 2 per cent and a 3 per cent solution of formalin. The dilutions were made just as in the preceding experiments, but instead of making plants in broth a loopful of the exposed culture was put into a full tube of melted agar and then poured into a petri dish which, as soon as the agar had hardened, was placed in the incubator.

The colonies were counted on the fourth day. Plants were made at 5-minute intervals, except in the case of *B. pyocyaneus*, when exposed to 3 per cent formalin, and then plants were made at 2-minute intervals.

It was found that with a two per cent solution of formaldehyde the maximum germicidal effect was exerted in the first five minutes.

With a three per cent solution this immediate effect is more apparent, and in the case of *B. pyocyaneus* the great mass of organisms is killed in the first two minutes.

ACTION ON FÆCES. Its germicidal action having been determined against pure cultures, experiments were done to determine its value as a disinfectant of human excreta.

Human fæces with urine added were thoroughly mixed with sufficient water so that there should remain no large clumps. A watery suspension from a number of 48-hour agar slants of *B. pyocyaneus* was added to the mixture and well mixed in, this being done on account of the green color it shows in culture, which was used as an index of the destruction of the non-spore-bearing organisms. To an accurately measured quantity of this mixture sufficient formalin was added so as to give a 3 per cent, 5 per cent or 10 per cent

dilution by volume of formalin. Plants were made into broth tubes and agar, which latter were at once poured into petri dishes. The growth in the broth tubes was observed for ten days; the colonies on the plates were counted on the fourth day.

A 3 per cent solution destroys a great majority of the non-spore-bearing organisms in fæces in the first 10 minutes, a few, however, resisting a somewhat longer exposure; the spore-bearing organisms grew up to 120 minutes.

Five per cent formalin acting upon fæces destoyed most of the non-spore-bearing organisms within 10 minutes; a few resisted 40 minutes. The spore-bearing organisms resisted as long as 60 minutes.

Fæces exposed to 10 per cent formalin solution were rendered practically sterile immediately; a few colonies developed in 10 minutes. The spore-bearing organisms were destroyed after 40 minutes.

A 10 per cent solution of formalin completely deodorized fæces at once. A 3 and 5 per cent solution rendered them almost odorless after a very few minutes' exposure.

On account of its germicidal efficiency and deodorant action formalin would seem to be one of the most useful agents for the disinfection of infected human discharges when used in a 10 per cent dilution, allowing an exposure of one hour after thorough mixing.

DISINFECTION OF SPUTUM. In order to determine the efficiency of formalin for the destruction of tubercle bacilli in sputum, the following experiment was done:

Ten cubic centimeters of sputum from an advanced case of pulmonary tuberculosis were added to 180 cubic centimeters of sterile water and the mass of sputum broken up as much as possible. An amount of the mixture of sputum and water equal to that used to inoculate the guinea pigs after exposure to formalin was given to a guinea pig as a

control. Sufficient formalin was added to the sputum to make a 5 per cent solution by volume. At intervals of 15 minutes up to 1 hour a small amount was given to a guinea pig intraperitoneally with the following result:

TABLE II.

TIME	DEATH IN	POST MORTEM FINDINGS
15 minutes.	71 days	Generalized tuberculosis.
30 " .	31 "	Generalized tuberculosis.
45 " .	72 "	Generalized tuberculosis.
60 " .	Killed 5 months later	No indication of tuberculosis; had gained in weight.

The control pig died in 35 days with lesion of generalized tuberculosis.

The experiment was repeated with another specimen of sputum with practically the same result.

It would seem, from the above, that 5 per cent formalin in one hour was sufficient to render tuberculous sputum harmless.

ACTION OF FORMALIN ON TETANUS AND DIPHTHERIA TOXINS. Aronson called attention to the fact that formalin in the proportion of 1 to 500 added to diphtheria toxin was sufficient to protect a guinea pig against 100 fatal doses of the toxin.

Burckhard found that formalin, when added to tetanus toxin in the proportion of 1 to 250, was sufficient to protect a mouse against a dose of tetanus toxin that caused the death of the control in twenty-four hours. Burckhard does not seem to have determined the fatal dose of his tetanus toxin.

Neither of them states how long the formalin was left in contact with the toxin before it was injected into the animal.

My work on the action of formalin was all tested on guinea pigs and the MLD of the toxins accurately determined.

Pure tetanus and diphtheria toxins, of which the MLD had been accurately determined, were exposed to various percentages of formalin for varying lengths of time. It was found that when tetanus toxin is exposed to 5 per cent formalin for six hours, a guinea pig is able to withstand 100 MLD of this formalinized toxin; that 3 per cent formalin after twenty-four hours' exposure protects against the toxin; that 3 per cent formalin, after one hour, destroys a part of the toxin, and that its action increases with the length of exposure.

Diphtheria toxin is more susceptible than tetanus toxin, as 4 per cent formalin, after six hours' exposure, protects a guinea pig against acute death, paralysis, however, not being prevented. One per cent, after twenty-four hours' exposure, has the same effect. Its action against the toxin increases with the length of exposure.

This action of formalin on toxin is an important property in its use as a disinfectant, for not only are the bacteria themselves destroyed, but their soluble products as well.

Attempts have been made to treat certain septicemic conditions by means of the intravenous injection of weak formalin solutions, but without much success. Perhaps more success would attend its use in localized infections where there is a nest of germs elaborating a toxin, which is absorbed and distributed throughout the system. This phase of the subject, it is hoped, will be treated in a later paper.

SUMMARY AND CONCLUSIONS. Formalin in the proportion of 1 to 5,000 was sufficient to restrain all bacterial growth in bouillon contaminated with garden earth. Molds developed in a dilution of 1 to 1,000.

In a dilution of 1 to 4,000 formalin restrains bacterial growth in bouillon contaminated with stable manure.

A dilution of 1 to 4,000 restrains bacterial growth in bouillon contaminated with wisps of hay. Molds developed in a dilution of 1 to 1,000.

A dilution of 1 to 3,000 restrained all bacterial growth in pure cultures of thirteen different organisms. Some were restrained in a dilution of 1 to 4,000 and a few in a dilution of 1 to 6,000.

One per cent formalin, containing 37.2 per cent aldehyde, killed the vibrio of cholera in 10 minutes, *B. coli* in 90 minutes, *B. diphtheriæ* in 20 minutes, *B. mallei* in 10 minutes, *B. pyocyaneus* in 40 minutes, *B. dysenteriæ* and *Staphylococcus albus* grew up to 2 hours, and *Staphylococcus pyogenes aureus* and *B. typhosus* were killed in 90 minutes.

Two per cent formalin (containing 37.2 per cent aldehyde) killed *B. coli* after 60 minutes' exposure, *B. diphtheriæ* after 10 minutes, *B. pyocyaneus*, 10 minutes, *B. dysenteriæ*, 60 minutes, *Staphylococcus pyogenes albus*, 60 minutes, and *Staphylococcus pyogenes aureus* and *B. typhosus* after 40 minutes.

Three per cent formalin (containing 37.2 per cent aldehyde) killed *B. coli* after 30 minutes' exposure, *B. dysenteriæ*, 40 minutes, *Staphylococcus pyogenes albus*, 30 minutes, *Staphylococcus pyogenes aureus*, 20 minutes, and *B. typhosus* after 20 minutes.

Five per cent formalin (containing 37.2 per cent aldehyde) killed *B. coli* and *Staphylococcus pyogenes albus* after 30 minutes' exposure, *B. dysenteriæ* after 40 minutes, *Staphylococcus pyogenes aureus* and *B. typhosus* after 20 minutes.

Ten per cent formalin (containing 37.2 per cent aldehyde) killed all the non-spore-bearing organisms tested in less than 10 minutes, except *B. dysenteriæ* and *Staphylococcus pyogenes aureus*, which were killed after 10 minutes.

With a 2 per cent solution of formaldehyde the maximum germicidal effect was exerted in the first 5 minutes.

With a 3 per cent solution this immediate effect is more

apparent, and in the case of *B. pyocyaneus* the great mass of organisms is killed in the first two minutes.

A 3 per cent solution destroys a great majority of the non-spore-bearing organisms in fæces in the first 10 minutes, a few, however, resisting a somewhat longer exposure; the spore-bearing organisms grew up to 120 minutes.

Five per cent formalin, acting upon fæces, destroyed most of the non-spore-bearing organisms within 10 minutes; a few resisted 40 minutes; the spore-bearing organisms resisted as long as 60 minutes.

Fæces exposed to 10 per cent formalin solution were rendered practically sterile immediately; a few colonies developed in 10 minutes. The spore-bearing organisms were destroyed after 40 minutes.

A 10 per cent solution of formalin completely deodorized fæces at once. A 3 and 5 per cent solution renders them almost odorless after a very few minutes' exposure.

On account of its germicidal efficiency and deodorant action formalin would seem to be one of the most useful agents for the disinfection of infected human discharges when used in a 10 per cent dilution, allowing an exposure of one hour after thorough mixing.

Bacilli in tuberculous sputum were killed after an exposure to 5 per cent formalin for 60 minutes. Sputum exposed for 15, 30 and 45 minutes respectively still contained live tubercle bacilli.

When tetanus toxin is exposed to 5 per cent formalin for 6 hours a guinea pig is able to withstand 100 MLD of this formalinized toxin. Three per cent formalin, after 24 hours' exposure, protects against the toxin; it destroys a part of the toxin in 1 hour, its action increasing with the length of exposure.

Diphtheria toxin is more susceptible than tetanus toxin, as 4 per cent formalin, after 6 hours' exposure, protects a guinea pig against acute death; paralysis, however, is not

prevented. One per cent, after 24 hours' exposure, has the same effect. Its action against the toxin increases with the length of exposure.

This action of formalin on toxin is an important property in its use as a disinfectant, for not only are the bacteria themselves destroyed, but their soluble products as well.

For details of experiments and full discussion of the literature, see "The Antiseptic and Germicidal Properties of Solutions of Formaldehyde and their Action upon Toxines," by John F. Anderson. Hygienic Laboratory Bulletin No. 39, U.S. Pub. Health & Mar.-Hosp. Serv., Washington, 1907, 48 p. 8vo.

THE DETERMINATION OF INTESTINAL BACTERIA IN MILK *

By DANIEL D. JACKSON
Mt. Prospect Laboratory, Brooklyn, N.Y.

A demonstration of the value of the lactose-bile medium for tests of intestinal bacteria in water has led to its use in the determination of the amount of contamination by fecal matter in milk. The fermentation test, using dextrose broth, gives utterly unsatisfactory results with milk, but the restraining action of lactose-bile solution on the growth of species other than *B. coli* admits of the use of the latter medium. This solution cuts out the growth of the other gas formers and stops the overgrowth caused by the more rapid multiplication of other bacteria, together with the consequent detrimental products of their metabolism.

The medium is prepared by sterilizing fresh undiluted ox bile directly after being drawn from the animal. It should first be tested for acidity. This is best done by adding ten cubic centimeters of bile to ninety cubic centimeters of distilled water, boiling for about one minute and titrating with twentieth normal sodium hydrate, using a few drops of phenolphthalein as an indicator.

The final end point is best found by examining the edge of the liquid in the six-inch porcelain dish for the appearance of the pink color. If more than four cubic centimeters of the twentieth normal sodium hydrate is required, the acidity is more than 20 by the Fuller scale and the bile should be

* Read before the Laboratory Section, American Public Health Association, at Atlantic City, September 30, 1907.

rejected as unfit for use, as neutralization does not remedy the defects caused by previous bacterial action. The usual and best acidity is about 5 Fuller scale.

The sterilization is best made in two-quart bottles, in an autoclave for 30 minutes at 15 pounds pressure. If gallon bottles are used, 45 minutes are required. By this sterilization the ropy consistency is changed and the albuminous material settles to the bottom of the bottle. These bottles of the sterilized bile are then kept in the ice chest.

When ready to be used the watery fluid is decanted and the last portion filtered through cotton. One per cent of lactose previously dissolved in a small amount of hot water is added and thoroughly mixed and the fermentation tubes are filled with the fluid. The tubes are then plugged with cotton and sterilized, taking care to raise and lower the temperature slowly, so as not to cause foaming and consequent blowing out of the plugs.

The fermentation tubes are 140 mm. long and 15 mm. in diameter, having an elongated bulb 38 mm. in its shortest diameter. This admits of the addition of 10 c.c. of the milk to be tested without too great a dilution of the medium. They are set in copper racks, holding twelve tubes, having six on each side, back to back.

If, instead of using the liquid medium for keeping and transporting purposes, the solid is preferred, the decanted and sterilized bile may be evaporated to dryness and kept in tightly corked jars. In this case 110 grams per liter is used to make up the liquid medium.

Contrary to expectation, it has been found that under ordinary conditions, considerable numbers of other bacteria being present, *B. coli* does not increase in milk, or if so only to a very slight extent and then gradually dies out. On this account the amount of the original contamination may be determined.

The dilutions required for the test fall within the same

lines as in water analysis. Amounts of one-tenth, one and ten cubic centimeters of milk are added to the fermentation tubes and incubated for two days at 37½ degrees centigrade. If *B. coli* is present, gas will be formed, usually in two days, which will occupy at least twenty-five per cent of the length of the tubes. In tubes where the gas is almost twenty-five per cent on the second day, the third day test is used.

Attention should be called to the fact that at an incubation temperature of 40° C. the lactose-bile test is *not* properly developed in testing either water or milk.

A clean milk, or one that has been pasteurized, rarely gives positive tests in ten cubic centimeters.

A milk that has been carelessly handled gives the test in one cubic centimeter and sometimes also in one-tenth of a centimeter.

A contaminated milk gives positive tests in all three amounts taken, and the positive results may at times be obtained even in much higher dilutions.

THE DIAGNOSIS OF RABIES *

By ANNA W. WILLIAMS, M.D.

In the New York City Research Laboratory, for the past two years, or since we have used the smear method in routine diagnosis, there have been 628 cases in all examined, including suspected rabies and controls.

These are divided into two groups, the first comprising the cases sent in from outside for diagnosis only, and the second the experimental cases.

When we began the work, in order thoroughly to test the smear method in diagnosis, we used comparative tests on a long series of cases, including many diseases other than rabies. The comparative tests were animal inoculations and a study of sections. The results obtained from a study of 141 cases were published in January and May, 1906, and our conclusions were that the Negri bodies, as shown by smears, as well as by sections, are specific for hydrophobia, and that the smear method for examining the Negri bodies is more rapid and efficient than any other method published. Since then, in our routine work, we have considered the presence of the Negri bodies in smears as diagnostic of rabies and have made no further tests except in those cases which we have used in our experimental work. Through this experimental work, however, we have added 112 cases to the list of those which had the comparative tests and our former conclusions have been more firmly established.

Before analyzing the 487 cases examined since May, 1906,

* Read before the Laboratory Section, American Public Health Association, at Atlantic City, September 30, 1907.

it may be well to state that by Negri bodies we do not mean any indefinite cell inclusion such as those found by Van Giesen in human meningitis, or by a few others in cats' brains, or by ourselves in dog and cat distemper. The more such indefinite bodies are found in other diseases, the greater is the evidence in favor of the specificity of the true Negri bodies.

Of the 487 cases, 260 are street cases and 227 experimental. Of the 260 street cases 185 showed typical Negri bodies, and 75 showed no definite forms. All of the latter and 29 of the former were inoculated into animals. The 29 all gave positive results.

Of the 75 classed under doubtful cases, 12 brains were too decomposed to show anything, 4 of these were positive on animal inoculations; 8 brains were soft and showed suspicious bodies, 2 of these were positive; 4 were in good condition and showed suspicious bodies, 2 of these were positive; the 59 remaining ones showed absolutely no suspicious bodies and all were negative to animal inoculations.

We see, then, that in all of our work controlled by careful animal inoculations we have never yet failed to have typical rabies develop in animals inoculated with material showing definitely structured Negri bodies.

Negative results after inoculation with such material must be interpreted by us at present as due to some error in technic, such as regurgitation or hemorrhage at the time of inoculation, emulsion improperly made, not enough of the virulent material taken because of localization of the organisms, etc. Possibly individual resistance of the animal inoculated might play a part. We have used principally guinea pigs, and some of them have shown enough irregularity in regard to the time in which they have come down with the disease to suggest a varied individual susceptibility, if other factors can be ruled out. So far, however, as I have stated, we have gotten no negative results with material showing Negri bodies.

On the other hand, some material in which we have failed to demonstrate typically structured bodies has produced rabies. All of this material, however, since we improved our technic, has shown suspicious small forms similar to those found in rabbit fixed virus. But any decomposing brains may also show, in smears, bodies very similar to these tiny forms, therefore it is difficult to rule out rabies in such cases. Such cases have become less frequent with the improved technic, and if, as we believe, the Negri bodies are living organisms, there is strong reason to hope that in time we may clearly demonstrate in smears the presence of these tiny specific forms.

Until such a time, however, animal inoculations must be used in these cases. Of course, the animal test will probably always have to be used with brains that are too decomposed to recognize any formed elements except bacteria, unless a reliable chemical test can be discovered.

So far with us fresh brains showing no Negri bodies and no suspicious forms have not produced rabies, but a few observers have claimed that such material has produced the disease. Therefore, until we can standardize our technic we must in all such cases use animal inoculations. We may, however, be reasonably certain that a case showing such negative material was not a case of rabies.

It is possible that some of these doubtful cases if killed early in the disease, before there has been time for general development of the virus in the brain, may have virulent sputum. The virulence of the sputum is said to be due to the passage of the virus through the salivary glands. We are now carrying on a series of experiments to test the comparative virulence of these glands and the brain in true and doubtful cases. Our results are yet too few to be tabulated.

We have already had an interesting case in which this method was apparently helpful. A Russian wolfhound with

a typical symptoms of dumb rabies was sent in for diagnosis. The brain showed many small fixed virus-like forms, which were considered suspicious. Guinea pigs were inoculated from brains and glands. Treatment was begun in a small child whose scratched hand had come in contact with the saliva. After twelve days, as no symptoms were observed in the guinea pigs, the treatment was discontinued. The pigs from the brain came down six and one-half weeks after the inoculation, while those from the glands are still alive ten weeks later. It was decided not to give more treatment to the child for this reason.

The question as to whether the sputum may be virulent and the glands not is an interesting one. It has been stated that the secretions from the mucous membranes of the mouth and naso-pharynx may also be virulent. If this were so, it would of course throw out negative results from gland inoculations. We are attempting also to solve this question.

The localization of the Negri bodies is another important point in making diagnoses. We have found well-developed bodies distinctly localized in different parts of the brain in several instances. In one horse there were small widely scattered areas of well-structured forms throughout the cerebellum, while tiny, indefinite forms were scattered through the rest of the brain examined.

In two human brains well developed forms were found in the corpus stratum and not in the rest of the brain. In several dogs the localization has also been marked.

The technic of our smear method is as follows:

1. The smears are made by pressing between a glass slide and a cover glass a small, thin section of the gray matter from (*a*) the cerebral cortex, (*b*) Ammon's horn, or (*c*) the cerebellum; the material is spread along the slide by moving the cover glass down with the finger.

2. When partly or completely air-dried the smears are fixed for about ten seconds in neutralized* methyl alcohol to which one-tenth per cent of picric acid has been added. The excess of the fixative is removed by blotting with fine filter paper.

3. The fixed smears are stained in the following solution:

Saturated alcoholic solution of fuchsin	1 drop
Saturated alcoholic solution of methylene blue	5 drops
Distilled water	10 c.c.m.

NOTE. — This solution, which is a modification of the one proposed by Van Gieson for staining the Negri bodies in smears, changes rather quickly at room temperature, but kept in the ice-box it gives good results for an indefinite time.

The stain is poured on the smear and held over the flame until it steams. The smear is then washed in tap water and blotted with fine filter paper.

With this stain the Negri bodies appear a magenta, the nerve cells blue, and the red blood cells yellow or salmon colored.

The following is the routine method of handling our material:

If the material is fresh, smears are made from the three parts mentioned in the slips and according to the method described there. If nothing is found, smears are made from various other parts of the brain. If still nothing is found, an emulsion is made of good-sized pieces from the different parts of the brain and intracerebral inoculations are made into three guinea pigs, about one-fourth c.c. of the emulsion is inoculated. An emulsion is also made of the different parts of the brain in glycerin for later inoculations, if for any reason the first should fail. Sterilized, neutral glycerin is

* The wood alcohol is neutralized by adding sodium carbonate (Na_2CO_3) about .25 gms. to 500 c.c. of the alcohol.

used. These emulsions remain active in the ice-box for over three months.

Contaminated, doubtful material is made into a weaker emulsion in order to lessen the number of bacteria.

The glycerinated emulsion made from part of the same material is inoculated after two weeks, unless positive results have been gotten from the weak emulsion.

THE MATHEMATICS OF THE BACTERIAL COUNT*

By H. W. HILL
Minnesota State Board of Health Laboratories, Minneapolis, Minn.

The use of bacterial counts, for the comparison of different degrees of purity in water supplies, for tests of water filters and in various quantitative determinations of bacteria in other fluids, has been overshadowed in importance of late by the use of bacterial counts in estimating the relative purities of milk supplies.

The bacterial count in water was first looked upon as affording an index to the purity of water, and the attempt was made to determine a standard. This attempt was found difficult and, notwithstanding that bacteriologists draw inferences from counts which they find of the greatest service, a standard for the purity of public water supplies has never been generally accepted. A standard for filtered water, however, has frequently been used, sometimes based on the percentage purification obtained, sometimes on a specified figure, sometimes on both.

A great many of the technical difficulties existing at the time when a bacterial standard for water was first chiefly discussed have been overcome since. Standard methods of collecting, plating and counting bacteria have been evolved, with an immense development of detail. The question of standards of bacterial purity for various types of public

* Read before the Laboratory Section, American Public Health Association, at Atlantic City, September 30, 1907.

water supplies might now be revived with a fair chance of reaching some decision. But, meantime, the pure milk question has resulted in the establishment of arbitrary standards, based, not on an attempt to establish what is to be regarded as purity, but to fix a limit on what must be regarded as impurity. The standard sought for water was the maximum which might be allowed without danger; that for milk, the minimum that might be secured without suspending the milk trade. The establishment of a standard of maximum impurity for milk has been a much more simple task than the establishment of a standard of minimum purity for water.

But, although the standardization of manipulative technique for securing uniformity of bacterial counts has been accomplished, the calculation of the counts, which is quite equally important, is left an open matter. The standard technique of "plating for bacterial counts" involves the use of 10 c.c.'s of medium, spread evenly in a four-inch (10 c.m.) petri dish. To this is added 1 c.c. or simple fractions thereof of the liquid containing the bacteria to be counted. These specifications are based on the best accepted practice and may be regarded as theoretically sound and practically useful, so far as manipulation goes. *A priori*, it might be supposed, and the earlier bacteriologists evidently did suppose, that plates thus prepared would indicate reasonably accurately the total number of bacteria present in the material tested, at least of those varieties which would grow under the conditions (media, temperature, humidity, and length of incubation) imposed, *without regard* to whether the number of such bacteria present were few or many, *i.e.*, that 1 c.c. of water, milk, etc., containing 100 growable bacteria would, when introduced into a plate, yield 100 colonies per plate, while 1 c.c. of water, milk, etc., containing 10,000 growable bacteria would yield, when introduced into a plate, 10,000 colonies per plate. I shall endeavor to show that this is entirely fallacious and to urge the true status. It is not a

new subject. I first urged it with regard to water, 1897.* Jordan, of Chicago, independently urged the same in 1899.† But it has not yet been generally recognized in practice.

The physical difficulty of making counts on plates containing large numbers of colonies induced the earlier bacteriologists to plate fractions of a c.c. rather than whole c.c.'s, when they suspected the material to contain high numbers of bacteria, in order to reduce the actual colonies per plate sufficiently to make counting easy. So long as this object was secured, no attention was paid to the overcrowding of the plate as a factor in the count. Counts were still reported from plates containing many hundreds of colonies, or even thousands. Indeed, much ingenuity has been expended to devise various forms of colony counters, with the express object of permitting accurate counts to be made in plates, containing great numbers of colonies, without any suspicion that the counting of such plates at all was radically wrong, and when protests against finicky accuracy in high counts were made, they were based merely upon the fact that close accuracy was not physically possible, and not important if accomplished, rather than upon any suspicion that a biological fallacy existed. It was found later, however, that a curious discrepancy existed between the calculated counts obtained from successively diminishing fractions of the same material. Thus, on plating a decimal series of fractional parts, results such as the following might be obtained:

	STRAIGHT	1/10	1/100
Actual count	7,000	1,000	150
Calculated count, 1 c.c. . .	7,000	10,000	15,000

This discrepancy was recognized as existing; of course, all these figures on the same c.c. of water could not be correct, and various explanations were offered. There were two methods

* Report on Brooklyn Water Supply, 1897. Hill and Ellms.
† American Public Health Association Transactions, 1899.

of securing the fractional parts of 1 c.c. for plating; one consisted in using a pipette graduated to tenths or hundredths and so measuring the actual fraction of the original which it was desired to plate. The second method, now generally conceded to be much more reliable than the first, and now almost universally adopted in practice, is that of adding to 1 c.c. of the original material 9 or 99, or other amounts of sterile water, and then plating 1 c.c. of the mixture, attaining the same end by a different process. Those who followed the dilution method explained the discrepancy in counts above described as due to the breaking up, in the process of dilution, of chains or groups of bacteria, which thus yielded as many colonies in the dilutions as the portions into which they were broken; while in the original plate made directly from the sample each chain or group, being unbroken, yielded only a single colony. A number of objections to this hypothesis can be made.

1. There is little evidence that chains or groups occur in water to any such extent as would account for the uniform occurrence of the discrepancy noted.

2. Chains and groups do occur in milk and in sewage, but they are broken up with considerable difficulty, and the manipulations incident to dilution are not sufficient to notably disintegrate them. (Rickards.)

3. If the original sample as well as each successive dilution be handled with equal severity of manipulation, shaking each violently twenty-five times, for instance, the discrepancy remains unaffected.

4. If the dilution processes alone caused the discrepancy, no discrepancy should be found in the direct fractional measurement of plating. But such discrepancies are found in both methods.

5. If the discrepancy depended on breaking up of chains or groups, it should be most marked in the plating of pure cultures of streptococci, sarcinæ, etc., and least marked in

the plating of cultures of organisms such as *B. prodigiosus*, which show no great tendency to chains or groups. But the discrepancy in both cases is practically the same, showing no relation to these factors.

Hence it is entirely fair to conclude that the breaking up of chains or groups is not a factor in the discrepancy between successive dilutions. In endeavoring to account for the discrepancy (a problem set before the writer by Mr. Geo. W. Fuller, in the course of the Louisville Water Filtration Experiments, in 1896), the writer observed that in successive dilutions made from pure cultures, *i.e.*, *B. prodigiosus*, not only was the numerical discrepancy parallel with that found in plating mixed cultures, as those, *i.e.*, from water, but that the actual size of the individual colonies increased in proportion as the dilutions rose: *i.e.*, in a plate containing 3,000 colonies, the colonies were very small; in a plate containing half a dozen colonies, the colonies were relatively very large. Of course, the same is true in mixed cultures, but in pure cultures it is extremely obvious. This suggested that the discrepancy was due chiefly to overcrowding. Routine work on water, done in two dilutions, were assembled and examined. It seemed obvious that if overcrowding were the chief factor, the greater the overcrowding the wider would be the discrepancy, and that if there were no overcrowding there would be no discrepancy. This was entirely substantiated by results which are quoted in the Report of the Brooklyn Watershed Laboratory in 1897; by Jordan, in the A.P.H.A. Trans. in 1899, and by many others, notably in the Appendix of the report of our Section Committee on Standard Methods of Bacterial Milk Analysis. (Am. Jour. Pub. Hyg., Nov., '07.)

It will be noticed that the higher the actual number of bacteria in the original sample, the greater the discrepancy between the plates made from the sample, and those made from dilutions of the sample. Anyone who chooses to do so may make tables for himself and so reproduce this work.

He will quickly convince himself of its truth and will also demonstrate that if the original sample contains not over 200 bacteria, successive higher dilutions will check with it, showing that 200 bacteria will grow in a plate without introduction of those factors of food exhaustion or direct antagonism, which we place together under the term overcrowding. Some results seem to show that 100 colonies per plate is the limit for milk, but this remains to be confirmed.

So far the writer has offered nothing practical to justify reference to this subject. The real reason for calling attention to it at this time lies in the fact that it is becoming a matter of serious public health interest that bacterial counts made in different laboratories should be made not alone with the same technical methods, *but also with uniformity of calculation.* If not uniformly calculated, uniformity in technique is of no advantage whatever. The weight given to the bacterial count in the production of certified and inspected milk, and in the bacterial supervision of market milk, makes it very essential that two laboratories engaged in examining the same milk should at least approximate the same results. This is quite impossible, notwithstanding uniformity in technique, if practically identical counts be calculated and recorded by different methods. To illustrate from actual practice: of two laboratories examining the same milk, one reported that the counts pretty uniformly approximated 10,000 per c.c. while the other reported pretty uniformly counts ranging in the neighborhood of half a million. Thus one laboratory would have approved this milk for certification, while the other would have condemned it utterly on the standards for both certified and inspected milk, and would have rejected some of it, at least, even as market milk.

Investigation showed that no serious discrepancies in methods, technique or media existed, in fact, both laboratories used the media made in one of them. Finally it was dis-

covered that the laboratory securing the high counts had diluted the milk to one in 10,000, while the laboratory securing the low counts did not dilute at all, but plated a whole c.c. of the milk itself directly. This latter laboratory did not and indeed could not get counts much over 10,000, because usually 10 c.c.'s of agar in a four-inch petri dish will not develop much more than about this number of countable colonies. Had they plated the milk diluted 1 to 10, the highest count they could have secured from any milk would have been approximately 100,000 of the same 10,000 colonies per plate.

This is not at all an extreme case; it illustrates the principle, at the same time pointing out the enormous errors in practice which may result from negligence or ignorance of what after all is an extremely simple and obvious point.

I do not know how many methods of calculating bacterial counts there are in existence, but there are three which I have seen in use, all of which are good, so long as they are applied to plates containing not over 200 colonies, but the first two of which yield entirely fallacious results when applied, as they are very likely to be, to plates yielding other numbers of colonies.

The first consists in calculating out, for each dilution made, the total bacteria per c.c., and them averaging the results by adding all the totals and dividing by the number of dilutions.

The second consists in adding the actual counts of colonies from the different dilutions and averaging by dividing by the total of the fractional parts of a c.c. plated in each case.

The third consists in regarding as reliable only the not overcrowded plate, whichever that may be; recognizing it in the fact that the count lies between 40–200, ignoring all others.

To illustrate: Suppose that a milk sample, which we will assume actually contains 2,000,000 bacteria per c.c., is plated in a decimal series of dilutions thus:

1 c.c.	1/10	1/100	1/1,000	1/10,000

The number of bacteria actually put into each plate will be

2,000,000 200,000 20,000 2,000 200

The number growing in each plate will be in round numbers somewhat as follows:

10,000 9,000 6,000 1,400 200

The number calculated as present in 1 c.c. taking each dilution by itself will be:

10,000 90,000 600,000 1,400,000 2,000,000

The number reported, by the first method of calculation, above described (*i.e.*, averaging the calculated counts from each dilution), would be 820,000; by the second method (dividing the total actual count by the fractions of a c.c. plate) would give:

$$\frac{10{,}000 + 90{,}000 + 6{,}000 + 1{,}400 + 200}{1 + 1/10 + 1/100 + 1/1{,}000 + 1/10{,}000}$$

or

$$\frac{26{,}600}{1.1111} = 24{,}000.$$

The third method will yield 2,000,000, or the correct count, as assumed. It will be remembered that the actual number present was 2,000,000 by hypothesis. Hence these methods of calculation give results of 820,000, 24,000 and 2,000,000, all from the same actual counts, one being about 1/3, the other about 1/90 of the actual number, the last being pretty close to the true figure.

Thus the real solution of this problem is very simple. If from the above actual counts all be eliminated except that lying at or below 200, the correct count is at once had. The counts from the other dilutions are simply neglected as overcrowded and hence of no value, except in so far as their increasing disparity as the scale of dilution is descended forms a consistent whole with the result recorded.

It will readily be seen from this example that if three different laboratories used the same technique, and plated a

milk containing actually from 100,000 to 200,000 bacteria per c.c., the calculated results might easily be such that one laboratory would approve the milk for market purposes only; the second would approve it for inspected milk but not for certification, while the third laboratory would approve it even for certification, all using identical methods and standards, except that of calculation of count.

It will be said that this is exaggerated, that in practice milks would not be plated in so many dilutions and that, therefore, in practice the laboratories concerned would report much more closely uniform results than those here suggested. It is quite true that I have so handled the figures as to bring out the results of applying logically the principles used in such a manner as to show them at their worst, but this is nothing more than the *reductio ad absurdum*, which is a perfectly logical and proper weapon.

It is only right to point out that extremely low counts are also unreliable. In the foregoing examples, had a dilution of 1/100,000 been made on the milk containing 2,000,000 bacteria per c.c., while 20 colonies would be the proper proportion per plate, it is unlikely that any one plate would yield this count, except by the merest accident. The average of several duplicate plates, however, at this dilution would be about 20, the individual plates ranging from 10 perhaps to 35 each. So if the 1/1,000,000 dilution had been made, it would be mere accident if a single plate yielded the proper count of 2. An average of many duplicates would range from 0 perhaps to 10 colonies, averaging about 2.

The unreliability of extremely low counts is due first to the purely physical difficulty of distributing a small number of bacteria equally in several c.c.'s of water, and second to the purely physical difficulty of so equally extracting from the water one c.c. as to leave the equal distribution undisturbed. With larger numbers of bacteria distributed in the same amount of water, these physical difficulties practically

disappear, so that plates showing from 40–200 colonies are quite representative. On this ground, dilution should be by fifths rather than tenths, since, proceeding by fifths any possible number must fall, in some plate, between 40 and 200.

To summarize:

I. Plating should be so done as to secure from 40–200 colonies per standard plate.

1. In order to have a number of colonies not too large to count completely.

2. In order that the size of the colonies may be large enough apart to facilitate isolation, if this be desired.

3. In order that the colonies may be large enough for ready appreciation by the eye.

4. And chiefly, because the standard plate, containing the standard 10 c.c.'s of standard medium, will not support more than about 200 colonies without detriment to the weaker forms.

II. In order to secure 40–200 colonies per plate, dilution by fifths instead of tenths is the logical method; but dilution by tenths gives results sufficiently close in practice. In general, for certified milk, dilutions of 1/100 should be made, giving a range of accuracy from 4,000 to 20,000; for inspected milk, dilutions of 1/1,000, giving a range of 40,000 to 200,000; and for market milk, 1/10,000, giving a range of accuracy from 400,000 to 2,000,000. When working to determine the actual count in an unknown milk, rather than to determine if a milk is above or below a certain standard, all three dilutions should be used, and the result selected should be that which gives 40–200 colonies to a plate. Straight or one-tenth counts on milk are rarely required, because few milks run low enough to make the counts at these dilutions accurate.

III. With water, dilutions of straight (or 1 c.c.) and of one-tenth, giving together a range of accuracy from 40–2,000, are usually sufficient. Unless highly polluted, dilu-

tions of 1/100 on water rarely give counts within the limits of reliability (40–200).

IV. With sewage, the dilutions used for market milk can usually be counted on to yield satisfactory results, *i.e.*, 1/10,000, giving a range from 400,000 to 2,000,000; but it is safest to plate also at 1/100,000, giving a range of 400,000–20,000,000.

V. All plating work should be done in duplicate when possible, but, if preferred, successive dilution "to the vanishing point" takes the place of duplication fairly well, *i.e.*, if in one case two plates from the same dilution run 190 and 180, and in another two plates run 190 and (with one-fifth dilution) 40, the check is equally good in both.

THE OPHTHALMO-TUBERCULIN TEST

A New Diagnostic Method in Tuberculosis *

By EDWARD R. BALDWIN, M.D.
Saranac Lake, N.Y.

As a result of v. Pirquet's studies on secondary or revaccination, a new test for tuberculosis was introduced by him into the children's hospitals of Vienna and Berlin. The observation that the primary vaccination was followed by the slowly developing pustule of vaccinia, whereas the secondary — while the immunity existed — pursued a rapid course with hyperemia, swelling and the formation of a transient papule without the actual infection of vaccinia, led v. Pirquet to see the analogy in these phenomena to those of other diseases. The classic experiments of Koch, which led to the discovery of tuberculin, are readily recalled in this connection. He noted that reinfection of tuberculous guinea pigs was not easily produced and the course was entirely different from the first. Marked local reaction and swelling occurred at the site of inoculation without the involvement of neighboring glands. This was accompanied by evidences of general reaction and other changes which led to the experiments with dead bacilli and ultimately the extract known as tuberculin for therapeutic and diagnostic use. v. Pirquet's experiments were made with scarifications of the skin as in vaccination, into which tuberculin (not

* Read before the Laboratory Section, American Public Health Association, at Atlantic City, September 30, 1907.

tubercle bacilli) was rubbed. A hyperemia and swelling followed in tuberculous children which was absent in the non-tuberculous, and constitutional disturbance was generally absent in the tuberculous. In 360 tests it was found to be a pretty reliable diagnostic criterion in children under two years of age. Unfortunately, older persons reacted more or less in all cases, and animal experiments were similarly unsatisfactory in the hands of Arloing, Vallée and Guerin.

On the basis of the cutaneous test the suggestion was made independently by Dr. Wolff-Eisner of Berlin, and Professor Calmette of Lille, France, that the conjunctiva might furnish a favorable field to exhibit the reaction without the necessitiy of scarification. The white background of the ocular conjunctiva indicates slight changes of hyperemia, owing to the rich supply of vessels, and gives a quick response to irritants, hence if tuberculin susceptibility is present the eye would be expected to reveal it to advantage, and with greater delicacy.

In the preliminary tests made on hospital patients this was found to be true by Calmette and Letulle. To avoid the irritant action of glycerin and other substances, such as beef salts contained in the old tuberculin, they employed a precipitated, dry tuberculin redissolved in water. The precipitate was obtained by adding 95 per cent alcohol to the old tuberculin, which, when washed and dried, was used in 1 per cent solution, one drop being instilled into the eye. A reaction occurred in all tuberculous patients save those in the last stages, and in none who were suffering from other diseases. About four hundred cases have been reported thus far, including all ages and diseases. Professor Comby of Paris reports 132 children tested with 0.5 per cent solution. Of 62 who reacted, post-mortem examination confirmed the diagnosis of latent tuberculosis in 6. Of the 70 who did not react, absence of tuberculosis was claimed for 4 who came to autopsy.

THE REACTION. After the instillation of tuberculin no perceptible irritation follows in the majority of healthy persons unless the strength of the solution is greater than that above mentioned. In individuals who are tuberculous at the time, or those who have recovered from a previous attack but still retain susceptibility, a scratchy feeling with secretion and redness of the palpebral conjunctiva and inner canthus develops in from 3 to 24 hours, and, in a few instances, as late as 48 hours. Exudation of leucocytes which gather into fibrinous or purulent collections occurs in moderately severe reactions, while in the most severe ones, œdema of the lids, deep congestion of both palpebral and ocular conjunctiva develops, with considerable discomfort, though severe pain is absent. After reaching its height, in from 12 to 24 hours, the reaction gradually subsides in the majority of cases in 3 days; severe reactions may exhibit swelling 4 or 5 days and redness for a week. Coryza of the nasal passage on the tested side has been noted in a few cases. No harm has yet resulted from the test and no change in the interior structures of the eye has been noted in my tests. No fever or local reaction in the tuberculous tissues has accompanied the eye reaction thus far.*

ITS EXPLANATION. The explanation of the specificity of this reaction is closely connected with the phenomena of anaphylaxis, which have been studied with such fruitful results by Rosenau and Anderson, Gay and others. When the cells of an animal have been subjected to the influence of foreign proteids, whether in the form of bacterial substances produced in spontaneous disease or purposely injected, there occurs a profound change in the functions and behavior of the cells to a subsequent exposure to the same substances;

* More recently several cases of phlyctenular conjunctivitis and keratitis, especially in scrofulous children, have been reported by various authors which should argue caution in its use.

the cells become sensitized and indicate this by a series of reactive phenomena, which range all the way from a local hyperemia and leucocytosis to grave multiple extravasations of blood and fatty changes with collapse and death. The response thus created is a manifestation of resistance which is not equivalent to immunity yet is a phase of it, which may be judged valuable in warding off harm when exposure to natural external infection is encountered.

In tuberculosis the extreme sensitiveness to tuberculin is well known; it is indicated by the rush of leucocytes and exudation to the site of injection as well as to the periphery of the tubercles. Hence individuals who have received enough infection to acquire a specific sensitiveness will exhibit the reaction in the conjunctiva to a greater or less degree.

The amount and duration of the sensitiveness are dependent on unknown factors, but we know that wide differences occur in different individuals, with disease of apparently equal extent. Reactive power is indeed more prominent in the earlier or latent stages, while in acute, disseminated types and the advanced stages it is often weak or absent.

The possibility of a non-specific susceptibility in the absence of the infection must be considered in some individuals who manifest idiosyncrasies in skin eruptions and rashes.

CONTRA-INDICATIONS. Any existing disease of the eye or lids, conjunctivitis, blepharitis, trachoma, keratitis and iritis, should be deemed sufficient reason to contraindicate the test. Eye strain from errors of refraction need not prevent its use so far as present experience is an indication. The tested eye should be kept from external irritation, such as rubbing, wind, dust or smoke.

METHOD AS APPLIED BY THE WRITER. A quantity of concentrated old tuberculin is poured into two vol-

umes of 95 per cent alcohol and the precipitate allowed to settle. It is then filtered and the sediment washed with 70 per cent alcohol until the filtrate is clear. The sediment is pressed between folds of filter paper, scraped off and dried over H_2SO_4 in vacuo. The lumps are powdered under a hood to avoid inhaling the dust and quantities of one per cent by weight are dissolved in normal saline solution, boiled, and any precipitate filtered. A portion is diluted one-half or two-thirds according to the reactive strength as ascertained on tuberculous patients, this being the only means of standardization.* The solutions are finally sealed into glass tubes, each containing a few drops, and boiled for ten minutes to insure sterility.† Any further precipitate is easily centrifugalized to one end before opening the tubes by breaking them at a file mark in a clean cloth; crumbs of glass are to be avoided in this procedure. The writer made use of two solutions which contained .33 per cent (No. 1) and .5 per cent (No. 2) respectively of the tuberculin, which in the preparation used seemed to be too strong in 1 per cent solutions. When No. 1 failed to produce a reaction, No. 2 was instilled into the other eye after twenty-four or forty-eight hours, thus avoiding unnecessarily severe reactions, and giving greater delicacy to the diagnostic test.

It appeared advantageous also to use a definitely measured drop, and for this purpose a calibrated eye dropper fitted with a Wright's "throttle" tube was adopted, which was graduated to .025 c.c. By holding the eyelid down until the drop spreads around the sac this amount is easily retained without overflowing on the cheek. It should not be instilled cold, and the dropper should be cleansed with alcohol and salt solution before use, to avoid accidental contamination.

* The advantage of making up a large stock for continuous use is obvious, as it does not deteriorate readily.

† Small capillary tubes like those employed for vaccine might be adapted to contain enough for one test.

The same eye should not be tested twice in succession, as there is some evidence to show that it becomes sensitized by the first test; this, however, requires further study.

The following schema was adopted for the purpose of recording reactions and comparing results:

SCHEMA FOR RECORDING REACTIONS.

NEGATIVE: No difference in color when lower eyelids are pulled down and compared.

DOUBTFUL: Slight difference with redness of caruncle.

X Distinct palpebral redness with secretion.

XX Ocular and palpebral redness with secretion well marked.

XXX Deep injection of entire conjunctiva with œdema of lids, photophobia and secretion.

CLINICAL OBSERVATIONS. The observations thus far made by the writer and his colleagues are here simply summarized, as the publication of a detailed study is contemplated later.

One hundred and thirty-seven persons have been tested, five of whom were controlled by the subcutaneous test. Of 45 tuberculous patients in all stages, 42 reacted positively, 1 was doubtful, and 1 advanced miliary and 1 tuberculin-treated were negative. Of 9 healed tuberculous persons (1 to 17 years healed), 8 reacted and 1 was doubtful. Of 26 individuals suspected because of history, symptoms or physical signs, 8 reacted positively, 4 doubtful and 14 negative. Of 57 supposedly healthy persons, 16 reacted, 8 of whom gave a family history of tuberculosis, 6 of close contact with tuberculous persons, and only 2 in which no such history was obtained. Among the 41 who did not react, 20 were farmers and guides living in the open air; most of the

others were in contact with tuberculous patients. In general the results correspond to those obtained with the subcutaneous test. Of the 6 who were thus tested all were negative to both tests save one who was known to have lues and reacted to .005 c.c. tuberculin. The figures with supposedly healthy people are not different from those obtained with the subcutaneous test, but idiosyncrasies must possibly be considered as playing some part in causing reactions until further experience and post-mortem observations shall establish the limits of specificity. Should it prove to be only one method of confirming the diagnosis of a suspected tuberculosis, and even then with but three out of four chances of accuracy, it will approach in value the subcutaneous test or the Widal test for typhoid.

Considering that individuals with clinically healed tuberculosis may give a reaction for an indefinite time, the test cannot at present be taken as a criterion either of healing or of the presence of active tuberculosis when no symptoms of this exist. Considerable care is therefore required in interpreting a positive reaction and, on the other hand, a negative result cannot now be asserted to exclude the presence of the disease.

In the general adoption of such simple methods great judgment is needed to avoid unnecessary alarm, especially to members of tuberculous families who have no symptoms of the disease, yet who may be found to react readily to this test. While thus capable of sounding a warning note to those who need it, sensitive persons might overestimate the importance of a slight infection or a long latent disease, which has little chance of becoming active.

THE RELATIVE VALUE OF DEXTROSE BROTH, PHENOL BROTH AND LACTOSE BILE AS ENRICHMENT MEDIA FOR THE ISOLATION OF B. COLI*

By S. C. PRESCOTT and C.-E. A. WINSLOW

From the Biological Laboratories of the Massachusetts Institute of Technology

One serious drawback to the use of dextrose broth for preliminary enrichment in the isolation of *B. coli* has long been recognized. This drawback lies in the fact that the organism, when present in the enrichment tube, is occasionally overgrown by other forms and fails to appear upon the litmus-lactose-agar plates inoculated from it. In order to obviate this possibility the use of phenol broth has been suggested, in the hope that phenol would check the growth of the interfering forms without inhibiting the colon bacillus itself. With highly polluted waters the phenol-broth method sometimes works successfully, permitting the isolation of *B. coli* when the dextrose-broth method fails. Phenol is, however, inimical to the colon bacillus as well as to other forms, and when only a few of the intestinal organisms are present they often fail to develop. Irons (1901), in the examination of 119 samples of waters, not heavily polluted, obtained 56 positive results with dextrose broth and only 37 with phenol broth.

When Jackson (1906) suggested the use of lactose bile as an enrichment medium it was hoped that a more definite selective action would be attained. It was claimed that the

* Read before the Laboratory Section, American Public Health Association, at Atlantic City, September 30, 1907.

bile medium would actually favor the increase of *B. coli*, while retarding the growth of streptococci and killing off most other body temperature forms. Jackson (1907) and Sawin (1907) report good results from the use of lactose bile.

There is little doubt that with sewage or very highly polluted waters the bile medium often shows the presence of gas-forming organisms which are entirely lost in dextrose broth. Sawin's work and that of Longley and Baton (1907) both bear out this view. In less heavily polluted waters, such as those with which we are ordinarily concerned in bacteriological water analysis, conditions are different. The danger of overgrowth is less serious and the likelihood that the few *B. coli* present may not develop in lactose bile is greater. Longley and Baton (1907), from their work on Potomac water, conclude that "the value of the test with the bile lactose on unpolluted or slightly polluted water, such as we have to deal with the greater part of the time, is uniformly less than with dextrose broth, except in the larger quantities of water." Sawin's tables show the same phenomenon. Although he states in the text that with waters of good quality there is little difference between the two methods, his figures show for wells and lakes 11 per cent of positive results in 1 c.c. with dextrose broth and only 4.3 per cent in lactose bile.

Sawin's argument for the lactose-bile medium rests on a comparison of presumptive tests alone, typical gas formation in lactose bile and dextrose broth, respectively, being considered positive. Various observations during the last few years have tended, however, to throw doubt upon the value of the presumptive test as an indication of the presence of *B. coli*. It appears probable that gas formers other than *B. coli* may frequently be found in waters which are not sewage polluted. The crucial test of the two methods can only be made by isolating sub-cultures, working them out in detail, and comparing the number of positive results in the two

cases. Weston and Tarbett (1907) report the result of such an examination of sixty-three samples of water. Eighteen gave no gas formation with either medium and twenty-four gave gas with dextrose broth, but not with bile; of these latter one showed *B. coli*. Eighteen samples gave gas with both media, and five in each case showed typical *B. coli*.

During the past spring and summer 176 samples have been examined in this manner under our direction in the laboratories of the Massachusetts Institute of Technology, and the results throw some additional light upon the comparative value of the bile and dextrose-broth enrichment processes. The samples were in all cases collected from surface sources, streams, ponds and pools which were more or less subject to pollution, exactly the sort of samples of which a bacteriological examination is most commonly desired. In each case one cubic centimeter portions of the sample were incubated in three enrichment media, dextrose broth, lactose bile and either lactose broth or phenol broth. Gas formation was recorded for three days and as soon as gas appeared litmus-lactose-agar plates were made and sub-cultures isolated and identified by the standard procedure of the American Public Health Association (except that motility was not determined).

We have arranged our results in four general groups. Positive results are those in which typical *B. coli* were isolated and negative results those in which no gas was formed in the enrichment medium. Atypical results are recorded when organisms were isolated which produced gas in dextrose broth and acid in lactose agar, but failed to give the reactions of *B. coli* in milk, peptone broth, nitrate solution or gelatin. The term "gas formation" has been used to designate that case in which gas formation in the enrichment medium was followed by negative litmus-lactose-agar plates. It may obviously be due to one of three causes; either to the development of a colon-like organism in the enrichment

medium which is so overgrown as not to appear on the plate, or to the presence of a form which produces gas in dextrose broth but no acid in lactose agar, or to the presence of forms which symbiotically ferment, and alone do not. In thirty-five cases this point was determined by reinoculating from the blue plates into the original enrichment medium. In thirty-one out of the thirty-five cases gas was again produced, showing that we had generally to deal with a form which fermented dextrose broth but formed no acid in lactose.

The first series of samples were collected and examined by Mr. H. R. Crohurst during the months of April and May, and the sum total of his results with each enrichment medium is as follows. With dextrose broth he obtained 25 positive results and 19 negative results; in 21 cases gas formation was followed by negative lactose-agar plates and in 3 cases atypical forms as above defined were isolated. With phenol broth he obtained 18 positive and 17 negative results; in 17 cases gas formation was followed by negative lactose-agar plates and in 3 cases atypical forms were isolated. With lactose bile he obtained 21 positive and 39 negative results; in only 7 cases was gas formation followed by negative lactose-agar plates, and one atypical form was isolated.

The second series of samples were collected and examined by Mr. A. F. Stevenson, also in April and May, 1907. With dextrose broth he obtained 12 positive and 21 negative results; in 11 cases gas formation was followed by negative lactose-agar plates and 8 atypical forms were isolated. With phenol broth he obtained 16 positive and 30 negative results; in 5 cases gas formation was followed by negative lactose-agar plates and one atypical form was isolated. With lactose bile he obtained 11 positive and 37 negative results; in only one case was gas formation followed by negative lactose-agar plates and 3 atypical forms were isolated.

Summing up these two series it appears that dextrose broth yielded 37 positive results, phenol broth 34 and lactose

bile 32. There is, therefore, no evidence here of any advantage from the use of the two media of special inhibiting power.

The third series of samples were collected and examined by Mr. W. C. Folsom during June and July of 1907. He used for enrichment dextrose broth and lactose bile as in the two first series, but for the third medium he used lactose broth instead of phenol broth. Everything in this series was done in duplicate, two tubes of each enrichment medium being inoculated and cultures worked out in detail from each. The effect of this procedure was to decrease materially the number of samples failing to give positive or negative tests. In many cases a negative lactose-agar plate was obtained after gas formation from one tube, while the plate from the duplicate tube yielded *B. coli;* often, too, after both lactose-agar plates were positive, one culture would prove atypical and the other typical. With dextrose broth, Mr. Folsom obtained 33 positive and 16 negative tests; in 6 cases gas formation was followed by negative lactose-agar plates and a single atypical result was recorded. With lactose broth he obtained 34 positive and 14 negative tests; in 7 cases gas formation was followed by negative lactose-agar plates and one atypical test was recorded. With lactose bile he obtained 32 positive and 22 negative tests; in one case gas formation was followed by negative lactose-agar plates and one culture proved atypical. A comparison of these results with those of the two preceding series shows clearly the advantage of duplicate determinations in eliminating dubious results.

The media employed in all these experiments were prepared in accordance with the formulæ of the American Public Health Association Standard Methods Committee, or of the authors who suggested the use of the particular media in question.

Comparing the lactose and dextrose broths used in this series it appears that the results are practically identical.

The results for dextrose broth and lactose bile in all three series have been added and tabulated in Table I. "Gas formation," as noted above, means that gas was formed in the enrichment medium, but that lactose-agar plates were negative. A negative result means that no gas was formed. "Atypical" means that a fermenting organism was isolated which failed to give *B. coli* reactions in milk, peptone solution, nitrate solution or gelatin.

TABLE I.

COMPARATIVE RESULTS OF *B. COLI* ISOLATION, DEXTROSE BROTH AND LACTOSE BILE

Result.	Number of Samples.	
	Dextrose Broth.	Lactose Bile.
Positive	70	64
Negative	56	98
Atypical	12	5
Gas formation	38	9
Total samples	176	176

These results seem to indicate that for waters which are not heavily polluted the lactose-bile medium is on the whole inferior to dextrose broth as an enrichment medium. It does indeed prevent the development of the organisms which cause overgrowth and of the gas formers other than *B. coli*. Thus the proportion of cases in which gas formation was followed by negative litmus-lactose-agar plates was materially decreased, as was the proportion of atypical cultures isolated. The bile medium, however, is also inimical to the colon bacillus itself, and the net result of its use with waters of this class is to diminish appreciably the number of positive isolations.

The use of the bile medium saves the bacteriologist from the trouble of replating a certain number of samples which, when replated, show only negative results. This occurred in 36 out of 176 samples in the work reported. Against this advantage must be set the longer time required for incubation in the bile medium. In dextrose broth when gas was formed it appeared in 66 per cent of the tubes in one day and in 97 per cent in two days; in phenol broth gas appeared in 52 per cent of the tubes in one day and in 98 per cent in two days; in lactose bile gas appeared in only 16 per cent of the tubes after one day, in 73 per cent after two days and in the remaining 27 per cent only after three days. Finally the fact that a certain percentage of samples containing *B. coli* gives negative results with lactose bile and a positive test with dextrose broth must be considered a serious drawback, even though the percentage is a small one.

In this discussion we have considered the bile medium only as a preliminary enrichment medium in the process for the complete isolation of *B. coli*. For this purpose it is inferior to dextrose broth. As a presumptive test, when the full working out of *B. coli* is impossible, the bile medium offers distinct advantages. If the proportion of cases in which *B. coli* was actually isolated (70 out of these 176 samples) be taken as 100, the percentage of complete, positive results, using bile for preliminary enrichment, was 91. If the dextrose broth fermentation test alone had been considered positive, 120 "presumptive" tests would have been obtained, or 171 per cent of the real number. On the other hand, the positive presumptive tests in bile, considering all gas formation as positive, would have given 78 positive results, or 111 per cent, only slightly in excess of the true value. As a presumptive test, the lactose-bile medium seems to yield a fair approximation to the truth, being far superior in this respect to dextrose broth.

REFERENCES.

Irons, E. E., 1901. Some Observations on Methods for the Detection of *B. coli communis* in Water. Transactions of the American Public Health Association, 1900 Meeting, XXVI, 310.

Jackson, D. D., 1906. A New Solution for the Presumptive Test for *Bacillus coli*. Biological studies by the pupils of William Thompson Sedgwick, Boston, 1906, 292.

Jackson, D. D., 1907. The Use of Lactose Bile Medium in Water Analysis. Journal of Infectious Diseases, Supplement No. 3, May, 1907, 30.

Longley, F. F., and Baton, W. U. C., 1907. Notes on the Determination of *B. coli* in Water. Journal of Infectious Diseases, IV, 397.

Sawin, L. R., 1907. Experience with Lactose Bile Medium for the Detection of *B. coli* in Water. Journal of Infectious Diseases, Supplement No. 3, May, 1907, 33.

Weston, R. S., and Tarbett, R. E., 1907. Comparative Results Obtained by the Use of Lactose Bile and Dextrose Broth Media for the Detection of *B. coli* in Water. Journal of Infectious Diseases, Supplement No. 3, May, 1907, 39.

THE SPECIFIC NATURE OF ANAPHYLAXIS*†

By M. J. ROSENAU and JOHN F. ANDERSON

From Hygienic Laboratory, Public Health and Marine-Hospital Service

From our first studies upon hypersusceptibility we were interested in the question, "Is this reaction specific?"

In our work upon the toxic action of horse serum‡ we showed that this reaction is quantitatively specific for serums; that is, guinea pigs sensitized with horse serum are subsequently very susceptible to a second injection of horse serum, but only slightly if at all susceptible to a second injection of the serum of other animals, such as rabbit, cat, dog, hog, sheep, chicken or man. Conversely, guinea pigs sensitized with the serum of these other animals are not very sensitive to a second injection of horse serum, whereas they respond actively to a subsequent injection of the same serum used for the first injection.

We have further shown§ that the specific nature of this phenomenon is more marked when proteid substances of widely different nature are used at the first and second injections. Thus a guinea pig sensitized with horse serum does not react to a subsequent injection of egg-white, vegetable proteid or milk. A guinea pig sensitized with egg-

* Journ. of Infectious Diseases, Vol. IV, 1907, p. 552.

† Abstract of paper read before the Laboratory Section, American Public Health Association, at Atlantic City, September 30, 1907.

‡ Hyg. Lab., Bull. 29, U.S. Pub. Health & Mar.-Hosp. Serv., Washington, April, 1906, pp. 1–95.

§ Hyg. Lab., Bull. 36, U.S. Pub. Health & Mar.-Hosp. Serv., Washington, April, 1907, pp. 1–67.

white does not react to a subsequent injection of horse serum, vegetable proteid or milk. A guinea pig sensitized with milk does not react to the other proteid substances mentioned.

We have recently succeeded in demonstrating more clearly the specific character of the phenomenon we are studying by proving that guinea pigs may be in a condition of anaphylaxis to three proteid substances at the same time. For instance, a guinea pig may be sensitized with egg-white, milk and horse serum and subsequently react to a second injection of each one of these substances. The guinea pig may be sensitized by giving these strange proteids either at the same time or at different times, in the same place or in different places, or by injecting them separately or mixed. The guinea pig differentiates each anaphylactic-producing proteid in a perfectly distinct and separate manner. The animal is susceptible to the second injection of each one of the three substances in the same sense that it is susceptible to three separate infectious diseases.

These experiments, which we now wish to record, were divided into three series. In the first the guinea pigs were sensitized with horse serum, egg-white and milk, in different parts of the body, but at the same time. In the second series the three substances were thoroughly mixed and then injected into the guinea pig. In the third series the animal was first given an injection subcutaneously of milk, fourteen days later an injection of egg-white, and fourteen days after that an injection of horse serum.

All of the animals, after at least fourteen days from the last injection, were then given the second injection of one of these substances. Those animals that survived the injection of the first substance were given, usually after an interval of one day, one of the other substances used, and those withstanding it were finally tested for susceptibility to the third substance used. As will be seen from the detailed experi-

ments, some of the animals survived after having had severe symptoms as a result of injections of all three of the proteids used.

Attention is drawn especially to one of the guinea pigs (No. 1,019). This animal reacted sharply to the second injection of milk. The guinea pig presented the usual symptoms from which it gradually recovered. *Five hours* after the injection of milk it was given an injection of egg-white from which it died. These two reactions in so brief a time seem to accentuate the specific nature of the phenomenon we are studying.

The following conclusions were drawn:

Guinea pigs may be sensitized to three strange proteids, viz., blood serum, egg-white and milk, at the same time. The hypersusceptibility to each proteid substance is manifested by a second injection of the corresponding proteid. The three reactions are as distinct and specific as three separate infectious diseases. We, therefore, feel justified in concluding that the phenomenon of anaphylaxis is specific. We further believe that this work indicates that chemical changes, rather than morphological alterations, lie at the basis of this reaction.

REPORTS AND PAPERS

PRESENTED TO

The Section on Vital Statistics

AT THE

THIRTY-FIFTH ANNUAL MEETING

OF THE

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PRACTICAL SUGGESTIONS FOR IMPROVING VITAL STATISTICS.

By Frederick L. Hoffman.

The accurate registration and qualified analysis of vital statistics is one of the most important functions of government. Vital statistics alone furnish a definite measure of the value of sanitary improvements and the progress of medicine and surgery. Vital statistics furnish the basis of an approximate estimate of national health, and they indicate with reasonable certainty tendencies making for national advance or deterioration. While considerable progress has been made in perfecting methods of registration and analysis, much remains to be done to secure uniformity in plans and purposes to increase the practical usefulness of the data collected. Much valuable material is collected which is not properly brought to public attention, and it is rather the exception than the rule that the official reports of health officers or registrars of vital statistics contain the extended and critical analysis of the vital facts of the community indispensably required for an intelligent understanding of the health history of the community. Most of the reports are limited to a crude presentation of the mortality data, and estimates of population are often arrived at by a method which falls little short of guess-work. As the result of a rather extended knowledge of methods of registration and the official publications of health departments throughout the United States and other countries, I have brought together a few suggestions for the practical improvement of our vital statistics, which, in one direction or another, may be applicable to the solution of local problems. Of necessity my remarks are limited to a brief statement of existing needs, with suggestions derived from actual experience. I am confident that most of the suggestions are entirely feasible, and that their adoption will materially improve the value of health reports for the purposes which they are intended to serve.

Annual Report and Sanitary Survey.

The annual report of the health officer should contain a brief sanitary survey of the locality reported upon, with observations upon the altitude, climate, surface geology, soil, subsoil, water supply, natural drainage, sewage and garbage disposal, and prevailing types of insects injurious to health. If possible, the report should be accompanied by a map

conforming to the standard of the topographic atlas sheets of the United States Geological Survey. Every ten years at least a special report should be prepared, conforming, on the whole, to the method adopted by the medical inspector of the Local Government Board for Ireland, in his Report on the Sanitary Circumstances and Administration of the City of Dublin, with special reference to the causes of the high death-rate.*

Preliminary Statement of Annual Mortality.

An abstract of the mortality from all causes and principal causes, including the mortality at certain ages, should be prepared as soon as possible after the close of the year, in conformity to the method adopted by the Department of Health of the City of New York. This report gives information for thirty-five specified causes of death, the mortality for four divisions of life, the general mortality by sex and color, with a separate statement of the mortality of Chinese, the deaths in institutions, tenements, dwellings, hotels, and a preliminary calculation of the crude death-rate.

Decennial Abstract of Mortality.

The mortality of the preceding decade should be presented in a convenient tabular form exclusive of the year reported upon, showing respectively the mortality from all causes and deaths by sex, color, and general nativity, also the deaths at ages under one and from one to five, together with the population accurately estimated for intercensal years.

* Report on the Sanitary Circumstances and Administration of the City of Dublin, with Special Reference to the Causes of the High Death-rate, by Surg.-Col. D. Edgar Flinn, F.R.C.S., D.P.H., Medical Inspector of the Local Government Board for Ireland, 1906.

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16. Particulars and Examples of Housing and Dietary of the Poorer Classes.
17. The Sanitary Staff of the Public Health Department.
18. Conclusion.

The method used in estimating the population should be stated in full, but, if possible, preference should be given to the arithmetical method for cities with a rapidly growing population. The mortality rates should be per thousand of population for the mortality from all causes and per ten thousand of population for specified causes. Deaths under one, and at ages one to five, should, in the absence of definite information regarding the corresponding population, be calculated in the form of a percentage of the deaths at all ages. This table should conform as far as possible to the method adopted by the Board of Health of the City of Boston, but in a somewhat more extended form.

Review of Mortality from Important Causes.

In the same manner the mortality from important causes of death should be reviewed for the preceding decade, exclusive of the year under consideration, including a statement of the actual deaths from each cause and the corresponding death-rates per ten thousand of estimated population for intercensal years. This method is admirably illustrated in the report of the Board of Health of Chicago, 1904–05. Among the more important causes to be considered should be small-pox, typhoid fever, malaria, phthisis, other tubercular diseases, all of the acute infectious diseases of children, pneumonia, other respiratory diseases, suicides, accidents, homicides, and deaths in pregnancy.

Early Vital Records.

Cities and towns with records extending over a long period of years should extend the decennial review for certain important diseases over the entire period of registration in the manner as this has been done in Table 13 of the Report of the Board of Health of Boston for 1906, and in the second volume of the Annual Report of the Department of Health for the City of New York (pp. 774–870). In this connection it may also be suggested that it would be of value if each registrar would state the history and extent of registration and give a catalogue of the books of record, such as will be found on pages 341 *et seq.* of the Annual Report of the Registry Department of the City of Boston for the year 1905.*

* Every board of health, municipal or State, publishing an annual report, should send a copy of the same to the Library of the Surgeon-General, U.S.A., Washington, D.C. This library has the largest collection of works on medical and sanitary science in the world, and the accessions are from time to time indexed in a subject index catalogue, of which a second series is now nearing completion. The library extends the loan of books and documents to qualified persons throughout the United States, under liberal rules and regulations, by which method the same become accessible to all. The library admirably serves the purpose of a central depository for reports of this character in the absence of properly supported medical libraries throughout the country, specialising in the direction of public health and sanitary science.

Mortality Record by Single Years of Life.

One of the most important additions to our present knowledge of human mortality would be a table of deaths by single years of life. No report of a board of health at present gives this specific information, which, for a variety of purposes, is of the greatest possible practical value. An attempt in this direction, however, is to be found in the annual reports of the Board of Health of Brookline, Mass., which require to be only slightly amplified to conform to the requirement stated. The Brookline report gives the mortality in the form of a running account of every death occurring, stating: first, the date; second, the cause; third, the sex; fourth, the conjugal condition; fifth, the exact age in years, months, and days; and, seventh, the occupation. In addition, however, the race and nativity should be stated. It may be difficult for large cities to present these facts in just the same manner, since in Brookline, during 1906, only 351 deaths were thus registered, but by means of this return any combination of facts can be worked out for a variety of purposes. Cities adopting the Brookline method should, however, in addition, tabulate the deaths, showing the number occurring at each age (and not by groups, as is the usual custom), with distinction of sex, color, and general nativity. Such a table would not require much labor, and would take up no more than a single page of the report. This method should also be adopted in the mortality reports of the census for the registration area of the United States.

Details of Infant Mortality.

The mortality of children should, if possible, be given by single months for the first two years of life and for the more important causes of death. As a rule, the mortality during the first year only is given by single months, but it would serve a very practical purpose to trace the course of mortality with greater accuracy by months during the second year of child life. This method has been adopted in the annual reports of the city of Berlin, and for the first year of life in the reports of the registrar-general of England and Wales. Wherever the information can be obtained, the distinction should be made between children breast-fed and bottle-fed, to trace with more accuracy the possibly injurious effects of artificial feeding. An excellent illustration of the method which should be adopted is to be found on page 50 of the Annual Report of the Medical Officer of Health of Blackburn, England, giving the particulars of the nursing and feeding of 2,705 children under seven months old visited by the inspectors of the department. The inspections were made by lady inspectors or health visitors, who also gave much valuable instruction to future mothers as a means of reducing infant mortality. It is hardly

necessary to add that the still-born should never be included in the statement of either births or deaths, but separately in a special table, with distinction of sex.*

Mortality of School Children.

The health and mortality of children of school age, say six to fourteen, should receive special consideration. A request might be made of school superintendents to report from week to week the deaths among pupils, so that at the end of the year a table could be prepared showing the average number of pupils in different schools according to different grades, together with the mortality occurring among the children, supplemented by a statement of the ages at death and the principal causes. There are few questions of more serious public interest at the present time than the problem of school hygiene and the possible effect of erroneous methods of instruction upon the health and mortality of the children. For illustration of the method which might be adopted, but which

* Infant and Child Mortality of Berlin, Germany,† 1905.

Ages under 1 Year.				Ages 1 to 5 Years.			
Ages.	Males.	Females.	Total.	Ages.	Males.	Females.	Total.
Still-born	988	854	1,842	13th month .	148	138	286
Found dead . .	15	11	26	14th " . .	129	112	241
1 day	398	277	675	15th " . .	112	122	234
2 days	187	121	308	16th " . .	83	78	161
3 "	116	85	201	17th " . .	79	79	158
4 "	53	43	96	18th " . .	58	60	118
5 "	48	30	78	19th " . .	54	64	118
6 "	40	35	75	20th " . .	48	55	103
7 "	41	29	70	21st " . .	52	61	113
1st week	898	631	1,529	22d " . .	46	41	87
2d week	302	210	512	23d " . .	51	36	87
3d and 4th weeks,	488	394	882	24th " . .	27	39	66
1st month . . .	1,688	1,235	2,923	1st year . . .	5,730	4,440	10,170
2d " . . .	685	526	1,211	2d " . . .	887	885	1,772
3d " . . .	664	449	1,113	3d " . . .	320	285	605
4th " . . .	512	389	901	4th " . . .	213	210	423
5th " . . .	431	331	762	5th " . . .	132	137	269
6th " . . .	349	286	635				
7th " . . .	297	283	580				
8th " . . .	254	238	492				
9th " . . .	249	208	457				
10th " . . .	221	170	391				
11th " . . .	207	176	383				
12th " . . .	173	149	322				

† Statistical Year Book, City of Berlin, 26th issue, 1907, p. 65.

should be simplified to show the ages at death, see "Health at School," by Clement Dukes, published in London in 1905 (page 547).

Mortality Record of Institutions.

For cities and towns which have large institutions, such as hospitals, asylums for the insane, prisons, almshouses, military academies, universities, etc., special tables should be given, showing the mortality among the inmates of such institutions, according to age at death and the principal causes, together with a statement of the average number of inmates of the institutions reported upon. Such tables would prove of very considerable value in connection with special mortality investigations, and at the same time correct erroneous conclusions regarding the health and mortality of particular localities. Illustrations of the method to be adopted are to be found in the annual reports of the various soldiers' homes and the numerous reports of asylums for the insane, and prisons, showing the death-rate among the persons under observation. These tables, however, as a rule, do not conform to the general method of showing the mortality at different ages and for specified causes conforming in principle to the international classification of causes of death.*

* For a very valuable table of mortality, by single years of life, useful for institutions such as prisons, asylums, almshouses, etc., the report of the managers of the National Home for Disabled Volunteer Soldiers should be consulted. The report of the board for 1906 was prepared by W. E. Elwell, surgeon-in-chief, and from a table on page 136 I extract the mortality by single years of life for ages 60 and upwards as follows:—

MORTALITY OF INMATES OF SOLDIERS' HOMES, YEAR ENDING JUNE 30, 1906.

Ages.	Number Cared for.	Number of Deaths.	Number of Deaths per 1,000.	Ages.	Number Cared for.	Number of Deaths.	Number of Deaths per 1,000.
60	1,598	62	38.80	81 . . .	299	39	130.43
61	1,936	97	50.10	82 . . .	257	38	147.86
62	2,249	95	42.24	83 . . .	165	24	145.45
63	2,368	100	42.23	84 . . .	170	22	129.41
64	2,200	105	47.73	85 . . .	158	15	94.94
65	2,199	120	54.57	86 . . .	127	15	118.11
66	2,329	108	42.08	87 . . .	71	15	211.27
67	1,844	95	51.52	88 . . .	55	7	127.27
68	1,769	115	65.01	89 . . .	35	1	28.57
69	1,627	86	52.86	90 . . .	14	3	214.29
70	1,303	104	79.82	91 . . .	13	3	230.77
71	1,167	102	87.40	92 . . .	21	2	95.24
72	1,197	88	73.52	93 . . .	9	1	111.11
73	983	87	88.50	94 . . .	13	2	153.85
74	844	64	75.83	95 . . .	6	2	333.33
75	744	71	93.03	96 . . .	6	–	
76	787	81	102.92	97 . . .	2	–	
77	574	65	113.41	98 . . .	5	1	200.00
78	479	45	93.95	99 . . .	2	2	1,000.00
79	412	53	128.64	100 . . .	1	1	1,000.00
80	349	54	154.72	104 . . .	1		

Fatality Rate of Institution Mortality.

For hospitals and similar institutions a special table should be given, showing the rate of fatality accurately calculated in conformity to the principles adopted by the London Metropolitan Asylums Board. The method, however, should be amplified to show the mortality from surgical operations. Valuable suggestions for the method to be adopted will be found in the annual reports of the Johns Hopkins Hospital of Baltimore. Most of the reports of hospitals and institutions are decidedly defective and more or less misleading, and uniformity of treatment, as well as improved statistical methods, are imperatively required. Since it is much more difficult to induce the different institutions to make necessary changes, it would be advisable for health officers to insist upon an accurate and specific return, to be incorporated in the annual municipal or state report.

Redistribution of Deaths in Institutions by Sanitary Districts.

Deaths in institutions should be redistributed according to the place or district of residence of the deceased, primarily, of course, to secure a more accurate return of the mortality by wards or minor sanitary divisions. No local sanitary survey can be of much value unless the actual mortality of each district is properly known, and serious errors result where the deaths in institutions are not redistributed according to the place of residence of the deceased. The effect of this error is particularly serious where hospitals for the treatment of special diseases, such as cancer and tuberculosis, attract a large number of patients from other sections of the city or the near-by country. This is probably one of the most serious underlying errors in most of the mortality reports of American cities, and, as I recall it, not even the city of New York makes a proper redistribution of deaths in institutions to correct the ward death-rates as published in its annual reports. If it is possible to make these corrections for as large a city as London, it would seem readily possible to do so for our large American cities. Claims are sometimes made, as in the case of New Orleans, that the entire mortality occurring in a large hospital should be deducted in the calculation of the local death-rate. There could be no more serious error in vital statistics than this, for it will be found upon careful inquiry that the actual mortality of non-residents in local hospitals is never as large as is hastily assumed. The value of this method and its application to local conditions is emphasized in the reports of Dr. Billings on the vital statistics of New York and Brooklyn, Philadelphia and Boston, Washington and Baltimore, published in connection with the census of 1890. An equally valuable and perhaps still more instructive illustration is

to be found in a map appended to the Annual Report of the Medical Officer of Health of Blackburn, England, for the year 1906, showing the death-rates in the enumeration districts of the borough of Blackburn. The existence of insanitary areas is readily traced by means of such maps, and the returns are, of course, of the greatest practical value when conceded to be accurate.

Mortality from Special Causes by Streets.

In connection with local inquiries into the causes of a high death-rate, it may be advisable to compile the mortality by streets, in much the same manner as this has been done for a number of years for Liverpool. For illustration, to emphasize the prevalence of diarrhœa during the year 1905, a table was prepared showing the mortality by streets on which three or more deaths from this disease occurred. It would not be difficult to obtain an approximate estimate of the populations of the different streets and to localize the mortality from any specific cause by this method.

Description of Sanitary Districts.

As a further aid in deliberate efforts to localize the causes of a high death-rate, the method adopted by the Registry Department of the City of Boston will be found of value, which includes a full account of the elements of population and the mortality of every ward in the city, including a brief but very comprehensive account of the topography and sanitary condition. The report is published as City Document No. 34, forming a very useful supplement to the report of the Department of Health.

Localization of Nuisances.

The presence of establishments more or less injurious to health, or which otherwise come within the category of local nuisances, may properly be indicated on a special map in much the same manner as this has been done in the biennial report of the Department of Health for the City of Chicago for the two years ending with 1905. This report contains a very instructive map showing the slaughtering and rendering plants, with the distinction of such as manufacture glue or fertilizers, also of tanneries and wool-pulling plants, which occupy considerable areas in the stock-yard district of the city. An amplification of this method will be found in the *Journal of American Sociology*, Volume VII, for 1901.

A similar method of emphasizing insanitary areas, or conditions giving rise to causes injurious to health, will be found in the first volume of the Report of the Department of Health of the City of New York

for the Year 1904, showing, among others, by means of a map, in part, the polluted watercourses of Staten Island, and places where oysters are freshened and unquestionably contaminated. A still more elaborate map, showing locations of stations in Boston harbor at which samples of water and shell-fish were collected for analysis, will be found in the Annual Report of the State Board of Health of Massachusetts for 1905.

Relation of Weather to Disease.

Epidemics of mortality from causes more or less connected with the weather, such as sunstroke and pneumonia, should be returned by single days for the period of exceptional frequency, supplemented by a daily record of the more important meteorological elements, in particular barometric pressure, minimum and maximum temperatures, rainfall, and humidity.

Mortality Rate from Infectious Diseases.

The mortality from contagious diseases should be supplemented by a table showing the number of reported cases, with distinction of age and sex. The fatality rate should not only be calculated in proportion to the total number of cases, but also separately, either by single ages or by periods of life. An illustration of this method will be found on page 45 of the Twenty-fourth Annual Report of the Superintendent of Health of the City of Providence, R.I., for the year 1906, showing the fatality rate from diphtheria for seven selected periods of life, first for the eighteen-year period, ending with 1905, and, second, for 1906 separately. The table, however, is for both sexes combined, which impairs its value, since it is desirable to have the information separately for the two sexes. It is also more advantageous to limit the comparative period to ten years instead of eighteen. An amplification of this method will be found on page 175 of the Annual Report of the London Metropolitan Asylums Board for 1906 and on page 39 of the Annual Report of the Medical Officer of Health of Manchester, England, for 1906.

Relative Value of Different Elements of Mortality.

The mortality returns by months should not be unduly elaborated, but limited to a few suggestive tables. Most of the board of health reports give an elaborate analysis of the mortality by months, which is of very limited value, instead of giving the necessary data by ages at death, which is absolutely indispensable. Of course, the mistake has its origin in the fact that the annual report, in most cases, constitutes a combination of the twelve monthly reports, but it would lead to a decided improvement if the analysis by months were eliminated in

many cases, and were replaced by tables showing the relation of age to cause of death. For many important purposes it is absolutely indispensable that the age and sex distribution of the mortality should be clearly stated, and every report should contain a complete statement of the mortality by important periods of life for each sex. This is the method which has been used practically from the beginning in the reports of the Registrar-General of England and Wales, and which also has been successfully carried through most of the tables of the United States census mortality reports. The vital statistics of the census, however, still continue to unduly elaborate the factor of season instead of giving due consideration to the far more important and fundamental elements of age, color, nativity, occupation, etc. As a matter of fact, the use of monthly death-rates has an extremely limited practical application, for, unless the mortality is given by days, it is next to impossible to trace the proper relation of diseases or mortality frequency to meteorological changes and departures from the normal. The annual mortality reports prepared under the direction of Mr. Wilbur are a decided improvement in this respect, but even these could be materially improved by a more complete separation of the mortality of the white and colored populations. I believe that it may be laid down as an axiom that, wherever the colored population exceeds 10 per cent. of the total, it should be considered the duty of the board of health to entirely separate the two mortalities and present the facts for each race by itself.

Mortality of Residents and Non-residents.

Every board of health report should clearly distinguish between the deaths of the resident and the non-resident populations, but only in the case of health resorts does it appear advisable to consider separately the mortality of non-residents in the calculation of the local death-rate. While the theoretical assumption probably does not hold entirely true, that the mortality of non-residents is balanced by the mortality of residents dying elsewhere, it will be found next to impossible to ascertain the facts with entire accuracy, except, possibly, in small communities. For illustration, the Board of Health of Brookline, in its report, makes a special tabulation of the deaths of Brookline residents who died in other places, and another of the deaths of residents of other places who died in Brookline. From various sources every health officer is likely to come into possession of information as to the deaths of residents in other places, and it perhaps would be advisable to make mention of such deaths in the report, without, however, incorporating the facts in the local mortality table. It would be a very important contribution to our knowledge of local mortality if mention were made of all

the important facts of this character, among others, for illustration, of deaths of residents occurring in tropical countries, such as Panama, the Philippines, etc., of deaths of residents occurring at sea, or deaths of residents committing suicide in other places, or who were murdered elsewhere, or whose lives were lost in railroad or other accidents. All such cases should be given, together with a statement of the age, sex, race, and nationality of the deceased, the place where the death occurred, and the cause in such detail as may be obtained. Where this method is adopted, the health officer will be, in fact, the public guardian of the life and health of *every* person properly considered a resident of the community, subject to the health department's jurisdiction, and a large amount of valuable information will be obtained regarding obscure deaths, which at the same time form an important element of vital statistics.

Suspicious Deaths and Coroners' Returns.

Coroners' returns should be given separately in addition to having been previously included in the general mortality tables. These returns are notoriously inadequate, and complaint as to their accuracy is universal, not only in this country, but abroad. As a Departmental Committee of the British Home Office observed in 1899, "We are so much impressed by the insufficiency and untrustworthiness of the statistics relating to particular causes of mortality which can be gathered from returns of coroners' verdicts that we venture, though the matter is outside the terms of reference to us, to recommend strongly that some steps should be taken to secure that these verdicts should lend themselves more readily to clear classification by the Registrar-General; and, in particular, we suggest that in every case where the coroner is in possession of a medical certificate of death, or where medical evidence has been taken at the inquest, a copy of that certificate, or an abstract of that evidence, should be appended to the coroner's certificate when sent to the Registrar-General." A separate return of inquests by coroners, or medical examiners, as they are known in certain New England States, forms a valuable appendix to the registration reports of Rhode Island and Massachusetts, but they are not in such detail as would be desirable. The Rhode Island returns omit the sex and age, but the individual observations are quite valuable. Considering, however, the great importance of complete knowledge regarding all sudden, suspicious, or violent causes of death, a statement in more detail would lead to a material improvement and increase the practical value of our vital statistics. It would not be going too far if the report were to give a complete individual account of every suspicious or violent death, not in the form of a tabulation, but in the form of a brief but continuous sum

mary, somewhat after the method used by coal mine inspectors in their reports upon fatal accidents and the method used in the annual reports of the Board of Gas and Electric Light Commissioners of Massachusetts. A valuable summary of gas accidents will be found on pages 100 *et seq.* of the report for 1906, and a valuable table of electric accidents on pages 109 *et seq.* of the same report.

Descriptive Record of Deaths of Exceptional Interest.

Deaths of exceptional interest should be individually made note of without necessarily any attempt at tabulation. Upon many important health problems our present information is very limited, due to the fact that cases of exceptional interest or rare occurrence are included in the statement of the general mortality. This, for illustration, is true of deaths among persons of races and nationalities as yet only represented in this country in very small numbers, as in the case of Chinese, Japanese, Filipinos, Hawaiians, Porto Ricans, Syrians, Turks, etc. All such deaths should be briefly reviewed, together with a statement of the age, sex, race, nativity, and cause of death. This is also true of deaths from exceptional diseases, such as leprosy, anthrax, etc. For illustration, the annual report of the State Board of Health of Massachusetts for the year 1905 contains the statement that a death from anthrax occurred in Lynn, and that one death from leprosy occurred in Boston, and another in Wareham. While this statement is of interest, and valuable as a matter of record, no intelligent meaning is conveyed by a reference limited to mere numbers. It is certainly of sufficient public interest to know the class of people among whom such rare diseases occur, and for any attempt to trace the possible course in the spread of such diseases more information is necessary, which cannot be had without access to the original death records, which also may fail to give a sufficient explanation. It would take very little time, and would add materially to the value of vital statistics, if all such cases were commented upon in some detail. This is also true of deaths among abnormal persons, such as giants, dwarfs, persons of great weight, and others which may be classed among the abnormalities or curiosities of medicine. The human life which is at stake in such cases has its own distinct value, and, while reports of such cases are made in medical journals or in the proceedings of medical societies, it is nevertheless important that they should also be mentioned and briefly reviewed in the reports of the local board of health. In all such cases, however, the sex, age at death, race, and nativity should be stated, together with the cause.

Race and Mortality.

Next to age there is probably no more important element in vital statistics than race. Every city which has more than 10 per cent. colored population should publish in its annual health report, in the form of a separate table, the mortality of the colored population, according to age, sex, and cause. Cities containing a fair proportion of Asiatics, such as the cities on the Pacific coast and some of the large cities in the East, should present the mortality of the Chinese, Japanese, etc., separately, with due regard to age, sex, and cause of death. While, for illustration, the Annual Report of the Health Department of San Francisco contains a table of the estimated Mongolian population and the deaths occurring among the same during a period of twenty-five years, the table does not show the causes of death among this class, by ages at death, without which it is impossible to arrive at any definite conclusions regarding the mortality and specific disease liability of this class of foreigners. Where the number of such deaths is small, it is fully sufficient to give the facts briefly, without any attempt at tabulation, sometimes in the form of a foot-note to the regular tables. For illustration, the Fifty-first Annual Report of the City of Providence for the Year 1905, on page 14, gives a total of the white and colored mortalities since 1855, but there is no specific information as to the causes of death among the colored, which would be of great value in connection with mortality investigations among the negro population in the North. The same volume contains a report of mortality by nativity and parentage, stating, among others, that there were deaths of Greeks, Turks, Syrians, Chinese, Armenians, etc., but with no information as to the age at death and the cause. The cumulative value of such information in detail would be very great.

Mortality from Industrial Diseases and Accidents.

Deaths among persons employed in dangerous or unhealthful trades should be commented upon in detail and at some length. The number of such trades is not very large, and is usually concentrated upon a few locally important industries. The method of presenting occupation mortality statistics is, as a rule, very crude, and the tables printed are of very limited practical value. The best work in this direction is to be found in the annual reports of the medical officers of health of Sheffield and Blackburn, England. In the former the cutlery trades are the most important, and in the latter the textile industries. The Blackburn reports are a model well deserving of adaptation by every board of health of cities in which cotton and woollen mills give employment to a large

proportion of the population. What is practicable for Blackburn, England, should not be more difficult for Fall River, Lawrence, Lowell, etc., and, if such tables were introduced, they would for the first time afford an accurate insight into the extent of industrial diseases in this country. The reports of the State Board of Health of Rhode Island contain much valuable information upon this subject, but they fall short of the required details in that only the average age at death is given among men dying in different employments instead of the age distribution by divisional periods of life and from the more important causes. There is no need for any very extended elaboration of the causes of death, most of which have no connection with the occupation followed. A selection could readily be made for different localities, but, on the whole, the method adopted in the decennial supplements to the reports of the Registrar-General of England and Wales will be found most useful. Where the reports are limited to particular trades, such as the textile industry, where, of course, the chief causative factor is dust in its relation to diseases of the lungs and air passages, the causes of death need not extend beyond tubercular and respiratory diseases and accidents. It would always be advisable, however, to give the facts separately for such diseases as asthma, bronchitis, pneumonia, etc. Dangerous trades, in which fatal accidents are likely to occur, such as iron and steel works, should be reported upon in detail for the different important branches of the industry, or, if this is not feasible, then a simple but continuous record of every fatal accident occurring should be given, stating the age, specific occupation, and cause of death of the deceased.

Modification of Occupation Clause in Death Certificates.

In this connection it may be well worth while to consider whether it would not be advisable to modify the death certificate now in use by the Census Office and local registrars of vital statistics, to the extent that two questions should be answered with respect to occupation: first, the certificate should state the industry in which the deceased was employed; and, second, the specific employment followed. Not only are there many occupations of the same name, but in entirely different industries, but the industry itself may be confused with another of a similar character. This, for instance, is true of the pottery industry, hat-making, iron and steel works, glass works, etc. If these suggestions were adopted, the certificate would state, for illustration, in the case of a glass worker, that he was employed in the glass industry, but that his specific employment was, say, that of a pot-maker. In the iron and steel industry it would be stated that, while deceased was employed in the iron and steel industry, his specific employment was that, say, of

a furnace keeper. Such a record would prove invaluable in connection with special mortality investigations, such as, for illustration, is at present being conducted in behalf of "*Charities and the Commons*" in the city of Pittsburg, as part of what is called the Pittsburg Survey of Social, Sanitary, and Industrial Conditions. There are few subjects of greater practical importance likely to receive extended consideration in the near future than industrial diseases and industrial accidents. The agitation for employers' liability laws, following the progress of such legislation in England under what is known as the "Workmen's Compensation Acts," must needs rest upon accurate data, which at present is next to impossible to secure for this country. For an illustration of the method which should be adopted, the second volume of the decennial supplement to the Fifty-fifth Annual Report of the Registrar-General of England and Wales should be consulted, also the supplement to the Forty-eighth Annual Report of the Registrar-General of Scotland. The last-named report is the most recent contribution to occupation mortality, which will soon be followed by the second volume of the supplement to the Sixty-fifth Annual Report of the Registrar-General of England and Wales, which is now in course of being printed.

Mortality from Accidents.

Accidents should be returned in some detail to show the causes, together with the ages at death, with distinction of sex. It does not serve a very practical purpose to merely state the number of accidental deaths from all causes, and not even the international classification is entirely sufficient. The causes of industrial accidents, as far as possible, should be separately stated, and it would be better to give more attention to details in the case of accidents than to details of the method employed in suicide. A tabular presentation of such facts will be found in the second volume of the Annual Report of the Department of Health of the City of New York for 1904, pages 760 *et seq.*, but, unfortunately, the table does not make the distinction of sex and age, which is decidedly important. A more satisfactory method of presenting the facts relating to deaths from accidents and negligence at different periods of life and in full detail for thirteen classes, subdivided into many minor groups, will be found in the Sixty-eighth Annual Report of the Registrar-General of England and Wales for 1905, pages 398 *et seq.* A somewhat similar table is contained in the sixty-third registration report for Massachusetts, for 1904, pages 120 *et seq.*, being the tabulation of the deaths investigated by medical examiners. Every such table, however, requires to be supplemented by intelligent observations or comments upon such accidents as are of public importance and which might suggest methods by which their occurrence could be prevented. It is probably

one of the most serious defects of all mere statistical representation of numerical aggregates that the value of the individual item is obscured. The law of large numbers applies only to vast aggregates, and not to such cases as represent decided variations from the normal. It serves only a very limited practical purpose to be told that there were four deaths from actinomycosis, two from glanders, and six from anthrax, or malignant pustules, in Massachusetts in 1904. To give such statement practical value, it is necessary to state the age, sex, and occupation of the person dying from such rare and infrequent causes in connection with collateral facts explaining their occurrence.

Mortality from Homicide.

Homicides should be reported in detail, with a statement of such facts as may have come to the notice of the health department. In all cases the age, sex, and race of the person dying a violent death should be stated and the method by which the life was terminated. Such cases, also, might be amplified by a brief explanation, to form a continuous public record of deaths from violence in the different communities. Here, again, our health reports are very defective, and the defect is so much more to be deplored in view of the extremely high rate of homicide frequency prevailing throughout the country. The English returns distinguish between murder and manslaughter, and the returns make the further distinction of sex and the method of murder employed. As far as practicable, the classification of method follows the method of suicide and the cause of accidents. While judicial statistics relate to the person committing the murder, such statistics do not throw sufficient light upon the fact as to the victim. Such returns, however, should not only be in the aggregate, but in addition state the age, sex, and method of death.

Mortality of Paupers.

Deaths of paupers should be stated separately, together with a statement of the mode of interment or disposition of the body. At present a serious defect exists in the vital statistics of some of our cities, in that they do not afford an accurate insight into the record of pauper burials, usually so referred to. Certain cities return a low pauper burial rate for no other reason than that the bodies of paupers are turned over to medical institutions. Of course, the deaths, as such, have been registered in the usual manner, but for certain purposes it is desirable to know the number of persons who come within the designation of the pauper class and whose bodies were not disposed of in the usual manner. Of course there is a further distinction to be made between pauper bur-

ials and pauper funerals, but it would seem advisable to give a table in the annual report, showing the disposition of bodies according to the different methods which may have been adopted; that is to say, whether the bodies were buried in public cemeteries or the potter's field at public expense, or whether the remains were turned over to medical institutions. I am not aware that any such record exists at the present time. A table stating pauper burials has a decided social and economic value, and it is a matter of regret that the returns should be so fragmentary and more or less inaccurate. All who are interested in this particular question should consult the Thirty-seventh Annual Report of the Sanitary Department of the City of Glasgow for the Year 1906, which contains an exceedingly interesting report upon the interment of unclaimed and other bodies, by Mr. P. B. Mackintosh, for thirty years one of the chief clerks of the department, performing the duty of seeing all those decently buried who, from one cause or another, died in poverty or were found dead in the city, leaving no one behind or sufficiently interested to afford the body interment. This very instructive report supplements the classical report by Edwin Chadwick on "The Practice of Interment in Towns," printed in 1843, and the more elaborate Report of the Select Committee of the House of Commons on Death Certification, published as a Parliamentary paper in 1893.

Necessity for a Complete Record of Deaths.

Every health officer should consider it his duty to obtain a complete account of the disposition of every body of a deceased person within the limits of his jurisdiction. Much valuable evidence upon this point will be found in the first and second reports of the Select Committee on Death Certification previously referred to. The disposition of bodies should be accounted for by cemeteries, crematories, or otherwise,—by otherwise, I mean the possible and entire destruction of a body in the event of explosion, by fire, drowning, etc. For illustration, deaths have occurred of miners whose bodies were never recovered, and workmen have been covered by molten metal in the explosion of furnaces, with the result that the bodies were entirely destroyed. It is manifest that such body destruction should be accounted for separately and distinct from the cemetery returns.

Description of Cemeteries and Method of Interment.

Every health report should also contain a brief account of the different cemeteries, their areas, and the probable number of interments in the same. Cities having crematories should return a separate record of the cremations in such establishments, and a valuable table will be found in the

Annual Report of the Board of Health of the City of Boston for 1906, which includes a review of cremations throughout the world from the inception of this practice. Such returns, however, should state the cause of death, as well as the ages of the persons cremated, to afford a more complete insight into this practice. For further information the report of a Departmental Committee of the British Home Department, appointed to draft regulations to be made under the Cremation Act of 1902, should be consulted. This report includes regulations for the maintenance and inspection of crematories, the conditions under which cremations may take place, disposal of ashes, and the registration of cremations.*

Descriptive Cases of Exceptional Longevity.

Exceptional cases of longevity (that is, persons dying at say age ninety or over) should, as far as possible, be verified by the health officer and explained in detail. The second volume of the Report of the Health Department of the City of New York for 1904 (page 768) contains a table of the deaths of persons one hundred years of age and over, giving the date of death, age, name, nativity, cause of death, and the borough in which the death occurred. There is, among others, the death of a Russian woman aged one hundred and six years and three months, but there is no evidence as to the facts in the case. As a check upon errors widely prevailing regarding old age, and the material improvement in longevity during recent years as the result of sanitary advances or more perfect medical practice, it would be advisable to amplify such records by the results of a special inquiry. It will be found, almost without exception, that such cases of very extreme old age are reported in the case of colored persons, or persons of Irish or Russian birth, or of certain other European nationalities, for which certificates of birth are practically unobtainable. An exaggeration of such cases is in part claimed to be the cause of an apparent increase in longevity according to recently constructed life tables, which are made to rest upon the recorded age at death, but not upon the deaths of persons actually living to the ages stated. The subject has been very carefully investigated by Mr. T. E. Young, formerly president of the Institute of Actuaries, in a remarkable essay on Centenarians, published in 1899. A very instructive address upon the subject of old age, by Metchnikoff, was printed in the Smithsonian Report for 1904. While it is possible, and perhaps probable, that old age is attained in larger proportions than formerly, it is of the greatest importance to have the facts properly authenticated and verified.

* The Annual Report of the Health Commissioner of Milwaukee for 1906, p. 102, contains an illustration of a method which might be followed. The table includes the statement that, out of 5,387 bodies, 16 were used for anatomical purposes.

Population Estimates.

Population estimates for intercensal years should be fully explained, and every safeguard should be employed against an overestimate of the population. An estimate, however, is in all cases preferable to a repetition of the census returns for a certain year, and death-rates should not be calculated upon such a basis of population, as is sometimes the case. A stationary population in an American city is an anomaly and is very rarely met with. Cities decrease or increase in population, and almost without exception the latter is the general rule. For cities normally increasing in population by an excess of births over deaths the geometrical rate of increase is probably the most satisfactory. Cities increasing in population by an excess of births over deaths and an excess of immigration over emigration will probably best employ the arithmetical method of estimating population. A full explanation of these different methods will be found in "The Elements of Vital Statistics," by Dr. Arthur Newsholme, medical officer of health of Brighton, England, while a brief statement of the principles will be found in Harrington's "Practical Hygiene." For more extended comment upon the estimating of population, the first volume of the supplement to the Sixty-fifth Annual Report of the Registrar-General of England and Wales should be consulted, which contains the "Observations on Population Estimates," by A. C. Waters, F.S.S., chief clerk of the General Registry Office. The subject is also discussed in the mortality statistics of the Division of Vital Statistics of the Census Office, and among others in the Sixth Annual Report for 1905 (page 4). The accuracy of population estimates becomes doubtful after the fifth year intervening between the taking of two decennial censuses, and, where there is no State census under proper management and supervision, recourse must be had to police enumerations, directory estimates, new buildings erected, etc., as a check upon possibly exaggerated estimates of population. It is much to be desired that the federal government should take a population census every five years, limited to the age, sex, race, and nativity constitution of the population.

Crude and Corrected Death-rates.

The crude death-rates as generally calculated, per one thousand of estimated population, cannot serve as an accurate method of comparison with other cities or towns even of equal population, unless the evidence is satisfactory that the sex, age, and race constitutions of the two populations were nearly the same. Even a comparison of the local death-rate with earlier years is likely to be misleading, if important changes in the elements of population have taken place during the in-

tervening period. All crude death-rates require to be corrected for such changes and differences in the elements of population, and the method of calculating corrected death-rates is also fully explained in "The Elements of Vital Statistics," by Dr. Newsholme. A brief explanation of the method of correcting the local death-rate is to be found on page 701 of Harrington's "Practical Hygiene."

Mortality Rates by Divisional Periods of Life.

Every health report should, if possible, contain a table showing the mortality rates for all causes, and specified causes, by divisional periods of life, calculated upon the basis of the number of living population at corresponding ages. Such tables may be calculated with approximate accuracy upon the basis of the age distribution as ascertained by the last census and applied in the form of a percentage to the population estimated for intercensal years. The method is admirably illustrated in the tables which have been published for many years in the annual reports of the Registrar-General of England and Wales, among others on pages 13 *et seq.* of the report of this official for the year 1905. In these tables the general death-rate for all ages has been corrected for changes in the age and sex constitution of the population since 1856, but specific death-rates are calculated for twelve divisional periods of life, with distinction of sex. (See also the Annual Report of the Medical Officer of Health for Manchester, England, for 1906, pages 14–15.)

Approximate Life Tables.

For localities with a reasonably stable population, not subject to an undue influx of foreigners or non-residents, approximate life tables may be calculated upon the basis of a ten-year average mortality, either by the approximate method adopted by Dr. Billings for certain American cities in connection with the censuses of 1890 and 1900 or the more refined methods adopted for certain English cities, such as Brighton, Oldham, Manchester, etc. Extreme care in the calculation of life tables, however, is necessary, and it is imperative that they should represent the true facts rather than a mathematical fiction. If the errors in age enumerations of the population are too apparent and too wide apart from the probably true condition, no method has yet been devised, nor is there any law of error, by which such disharmonies can be reduced to a normal basis, whether it be the graphic or any other method known to actuarial science. The errors and fallacies in life tables are, unfortunately, very far from being generally recognized, but they were never more clearly set forth than by Dr. Rumsey in his address before the

Manchester Statistical Society, where he discussed the question, "Are Life Tables, National or Local, Evidence of Sanitary Condition?" The essays were republished in 1875 under the title "Essays and Papers on Some Fallacies of Statistics concerning Life and Death, Health and Diseases, with Suggestions towards an Improved System of Registration."

These are only a few illustrations of the direction in which the practical value of vital statistics can be very materially increased. Many matters have been necessarily left out on account of the limitation of space. Among those which perhaps should have been included are graphic representations of statistical results in the most readily comprehended form; the statistics of childbirth, by ages of mothers and previous issue, as admirably illustrated in the reports on the vital statistics of New South Wales; the mortality of the married and single, by ages at death and causes in a somewhat more extended form than was used in the Census of 1900. To some of these I have had occasion to call attention in my review of "The Vital Statistics of the Census of 1900," published in the *Quarterly Publications* for December, 1902, and "The General Death-rate of Large American Cities, 1871–1904," published in the *Quarterly Publications* for March, 1906.

THE IMPORTANCE OF UNIFORM METHODS IN THE PRESENTATION OF VITAL STATISTICS.

By Wilmer R. Batt, M.D., State Registrar of Vital Statistics of Pennsylvania.

The Act of Congress of March 6, 1902, establishing a permanent Census Bureau, and providing for the publication of annual instead of decennial reports, marks the beginning of a distinctly new epoch in the collection of vital statistics in this country.

By this action the work has not only been vested with the just appreciation which its importance warranted, but it presumes for the future a degree of accuracy and reliability of data which can only be derived from a continuous and not from a periodical operation of a statistical bureau. There will be no more ten-year comatose periods in our vital statistics, and in the future it will not be possible for half of a generation of our people to appear and disappear without some definite knowledge of their coming and their going. It is not too much to say that this substantial national recognition of a national necessity is, and must forever remain, the most important event in the history of our vital statistics. It is, furthermore, not inappropriate to state at the same time that this result must stand as a monument to the Bureau officials of the Census Office; to the ability and zeal of those citizens who, as individuals, labored so effectively in the cause; to the support of the organized medical societies of the country, and, last and by no means the least, to the influence of the American Public Health Association.

But slightly secondary in importance to the establishment of a permanent Census Bureau was the action of Congress of Feb. 11, 1903, when by preamble and resolution the value of vital statistics was impressively set forth and the necessity for State legislation emphasized. The immediate effects of the acts above referred to, supplemented by the vigorous work of the Census Bureau, are to be found in the pamphlet on the "Extension of the Registration Area for Births and Deaths," issued November, 1906, in which the announcement is made that five additional States have enacted and inaugurated laws sufficiently comprehensive to entitle them to recognition and inclusion in the permanent registration area, and that a number of others give promise of inclusion in the near future. The net result has been the addition of 8.0 per cent. of our total population to the area for the registration of deaths.

In reality the extension is of much greater importance than this percentage would indicate for the reason that a number of large cities with extensive populations in the added territory were already included in the registration area through the operation of purely local laws, but it may be safely assumed that the true index of statistical sentiment and progress is not to be found in isolated municipal regulations, but in the legislative recognition which provides for State registration. The preponderance of statistics relating to urban population is likewise reduced through the admission of entire States, and a better analysis is afforded of results under a wider variety of actual conditions. Expressed in proportion to the total number of States and Territories, the registration area in 1900 represented 22 per cent. of the total, and, in 1906, 32 per cent.

These facts show just what has been accomplished in the short space of five years in the matter of establishing uniform methods in the collection of mortality data. If these data are to have their greatest possible value, there remains for our earnest consideration the importance of uniform methods in their presentation for general use.

The Act of Congress of Feb. 11, 1903, before referred to, in urging the adoption by State legislatures of specific laws for the collection of vital statistics, also calls definite attention to the fact that the National Census Bureau is wholly dependent upon State legislation for the enacting and compulsory enforcement of such laws. The sovereignty of the several States in such matters is freely and fully admitted, and the actual definition thereby placed upon the work of the Federal office consists in the collaboration and analyses of such data as are transmitted to it through the medium of State registration offices.

Such being the facts in the case, the question naturally presents itself, If the information in detail forwarded to the Census Office is exactly identical with that received in State bureaus, should not the presentation of the aggregates as well as the separate groupings of facts in tabular form by the State and Federal offices exactly coincide?

It must be very evident, when entirely different results are reached by independent treatment in separate offices of supposed identical facts, that one or perhaps both compilations are inaccurate. In either event the value of the results is necessarily discounted and opened to serious question. During the period included in the decennial publications of the Census Office (1850–1900) any inquiry involving mortality statistics during intercensal years required the use of annual State reports. If the inquiry required comparisons between conditions in several States, the incongruity in the treatment of certain statistical facts often made useful comparisons impossible.

Futhermore, when the annual State reports for several years are

compared with census reports for the same periods, a disparity is frequently found, not in details alone, but in aggregates, to such a degree that it might easily be inferred that the compilations were based upon information derived from entirely independent sources. In fact, it requires but a glance to note the entire lack of uniformity existing between National, State, and Municipal reports of vital statistics, with the result that all must inevitably be more or less tainted with a suspicion of inaccuracy and incompleteness. The matter of correspondence in data between the State bureaus and the municipalities in registration States may be a question for local adjustment, and there may be some urgent reasons for the presentation of data relating purely to local conditions which might require special treatment, but as between the State and National publications there should certainly be a correspondence in aggregates and in the primary basic tables that would demonstrate an absolute uniformity in the methods of digesting and treating identical facts. Discrepancies that have heretofore existed in comparisons of the censal year reports will be in greater evidence in the comparisons of annual reports and less excusable.

It is rather confusing to the users of statistics to discover that the United States Census Bureau finds 157 more deaths for a certain year in one registration State than are admitted in the State report for the same year; or that in another State it finds 601 more deaths than the State records for the same period; or that, according to the census reports, 259 more people died in a certain State during a given year of organic heart disease than the same State reported. Of course, when assignments to titles are made by several persons acting independently of each other, especially in the case of joint causes, where individual preference in the absence of any hard-and-fast rules very largely determines the choice, we would certainly expect to find disagreements.

Heart disease probably occurs more frequently in joint causes of death than any other single affection, and it might reasonably be urged that a comparison of deaths under this heading is not a good index of discrepancies in treatment.

If, however, we compare the deaths from typhoid fever, concerning the assignment of which there should be the least doubt, we find similar disagreements. True, not as large a proportion as for heart disease, but enough to create a material difference in the rates accorded to this affection.

There should not be a disagreement in such definite causes as suicide and homicide, and yet we find that in one year a certain registration State reports 18 more suicides than the Census Office finds, another State 55 more, another 40 more, while yet another state report shows 14 more homicides than the census reports, and in another the con-

ditions are reversed, as the State reports 3 less. Discrepancies as to sex, age periods, nativity, color, and occupation must follow as a natural sequence when there is a variance in the total number of deaths from all causes or from any specific cause. The arrangement of titles shows, even in cases where the International Classification has apparently been adopted, that decided liberties have been taken with groupings and arrangements, making it difficult to locate certain titles, and that combinations or subdivisions of titles have been used without explanation, which makes comparisons impossible.

When municipal statistics are brought into the comparisons, we have simply added an additional element of uncertainty, for the disagreements noted between National and State reports are equally evident between State and Municipal reports.

In view of these facts, upon what basis can State registrars seek to defend the completeness or accuracy of their statistics, even so far as totalities are concerned, when placed in comparison or competition with Census Bureau reports based upon information supplied by their offices? Exactly the same proposition applies to local registration records, as compared with the State reports.

It is very apparent that the gradual perfection of statistical methods and the broadening of the registration area must result in a more extensive use of statistics, and consequently in a more critical examination of results. The development of statistical sentiment on the part of the public will also require that vital statistics must not only be published, but that they must be intelligently interpreted; that cause and effect be so clearly demonstrated that the conclusions drawn must be convincing to the public through the sheer force of their unanimity.

While it is true that the principal effort on the part of the Census Office has in the past been directed primarily to the extension of the registration area by the adoption of uniform methods in the collection of vital statistics (for without such data there should be no comparisons), the importance of uniformity in the presentation of such statistics has not been lost sight of.

The American Public Health Association at its annual meeting in December, 1902, by resolution recommended the "proper compilation and presentation of vital statistics." Exactly the same language was used by the American Medical Association in the resolutions adopted at the annual meeting in May, 1903. The preamble of the Act of Congress of Feb. 11, 1903, urges the importance of "a practical uniformity in the character and amount of information" available from statistical returns.

The Director of the Census in his introduction to the annual mortality reports of 1900 to 1904, in outlining the work to be pursued in the im-

provement of registration methods, speaks of the necessity of uniformity of tables and of classification. At the last annual meeting of this Association, Dr. Wilbur, Chief Statistician for Vital Statistics of the Census Office, in his "Report on the Condition and Prospects of Vital Statistics in the United States," speaks of the value which must inevitably accrue to all statistics through uniformity in presentation.* There is no division of sentiment upon the subject.

Such being the case, and the expediency of State and Municipal publications of vital statistics being admitted, how can uniformity in their presentation, as compared with each other and with national statistics, be secured, and how far in detail can it be carried out?

The first logical step in this direction would seem to be the adoption and use by States and Municipalities of the International Classification, both as to groupings and order of arrangement, exactly as it is employed in the Census Bureau. This may involve the sacrifice on the part of some statisticians of certain deep-rooted convictions which they may have concerning the practical utility of this classification.

Modern pathology, has indeed shown us the necessity of revision and extension of titles and arrangements, while medical nomenclature has at the same time so broadened the field of expression that assignment to titles and groups is constantly becoming more difficult.

When we stop to consider, however, the circumstances under which the International Classification was devised, and how extensively it has been adopted, that it forms the basis of our national vital statistical work, and that some such uniform method is urgently required, it would seem as though all individual sentiment in the matter should be thrust aside to the end that uniformity in the very primary work of tabulation should prevail, and that a common ground should be established for comparisons.

Moreover, the adoption and use of this classification would not prevent the statistician who desired to do so from expressing, in subsidiary tables or in text, any facts which to his mind required a different treatment or expression. It would not necessarily prescribe any limitations whatever, and would certainly not detract from the value of such work.

The uniform assignment of individual cases to identical titles by independent editors necessarily involves comparisons and mutual agreements. In the paper by Dr. Wilbur, before referred to, mention is made of the efforts now being made in several states to secure uniformity in assignments. The instance in which disagreements are most likely to occur will, however, form but a small percentage of the whole,

* Papers and Reports of the American Public Health Association, vol. xxxii, Part 1.

and will not necessitate the great amount of work which at first thought might seem to be prohibitive. The great majority of cases will fall naturally into their proper assignment, and joint causes will be found to originate the largest number of disagreements. Here, again, a Manual of Classification, dealing with a uniform preference in such cases, will still further reduce the number of such requiring mutual consideration. When agreements on the arrangements of tables and titles and assignments to titles have been accomplished, it naturally follows that aggregates will correspond, and that uniformity as to totals for sex, age periods, nativity, etc., will present no difficulties.

When mortality rates based upon population are to be used in the several publications, then there should be a further agreement upon the population to be used as a basis for these calculations. Discrepancies in the estimated populations of intercensal years for various cities and States as made by the Census Office, in comparison with those employed by local authorities, are very prominent, and in many instances the divergence is so great that rates are seriously affected.

From a popular standpoint the use of rates rather than the actual totals seems to be growing in constant favor for purposes of comparison, and, in order that these comparisons shall not become misleading, it is necessary that the subject of population, not only in the aggregates, but in its component parts, be given serious and mutual consideration by registration officers.

There is nothing impossible in the whole proposition, either as it refers to the National and various State bureaus or to the State and Municipal bureaus. It simply requires a close sympathy in the work of the several offices.

The present system, with uniformity the exception rather than the rule, reflects discreditably not only upon statistics and statistical methods in general, but upon statisticians who, while ostensibly journeying along the same road towards the same objective point, all seem to arrive at different destinations.

With the primary object of registration already successfully promoted in a large territory, there should certainly be a determined effort to make our National Vital Statistics the epitome of accuracy, and to this end there should be a co-ordination that would show National, State, and Municipal statistics to be part of one organic system, with uniformity in detail, treatment, and conclusions.

THE MORTALITY FROM CONSUMPTION IN SMALL CITIES.

By Frederick S. Crum.

The main purpose in this paper is to point out some of the many ways in which the registrars of vital statistics in small cities may render valuable service by making careful and detailed studies of local conditions as reflected in the mortality returns. I have purposely chosen small cities, first, because they have been long neglected, and heretofore attention has been directed almost wholly to the large cities, and, secondly, because the small cities often afford quite exceptional opportunities for the study of certain phenomena in the field of vital statistics, which, because of the size of the population and the large variety of conflicting influences, are rarely, if ever, afforded by the great cities. In the past there has been one very good reason why the small cities have received little attention from the students and investigators of vital statistics in this country. Until very recently, with certain important exceptions, the necessary data have not been available for small cities. This excuse, however, can no longer be offered, for the permanent Bureau of the Census, in its annual reports on mortality, has already compiled much valuable material for nearly three hundred cities of less than 50,000 population, and this information is now available for the six-year period 1900–05.

I hope and expect to see additions and improvements continually made in these mortality statistics, as they appear from year to year, but these expectations are to be realized only by the further extension of the registration area, by the incorporation in the reports of certain important additional details, and by the hearty co-operation of the local registrars throughout the country with the Division of Vital Statistics of the Bureau of the Census.

That the small city often affords exceptional opportunities for the study of the effects which various factors have upon the health and longevity of population, I shall hope to prove convincingly in the course of my argument. Suffice it now to say that any one, two, or more influences which may powerfully affect the health or mortality of a given population can best be isolated in a city of moderate size. An occupation or trade, for example, which is centred in a city of 10,000 population, is more readily studied in its effect upon the health of the men and women engaged therein than would be possible if the same numbers were employed in a city of 500,000 or 1,000,000 population. In the

first place the facts pertaining to the health and mortality of the employees are more readily ascertainable in the small city, and, secondly, the influences of environment, such as latitude, climate, housing conditions, habits, etc., can be weighed better in small than in large cities.

For the basis of this study I have taken 209 registration cities, all but two of which, Pueblo, Col., and Sacramento, Cal., had an estimated population of less than 30,000 in 1905. Pueblo and Sacramento had less than 31,000 population, and they were included because they illustrate certain more or less typical facts. The cities selected may be considered fairly representative of their class for Northern and Western States. They are scattered over the country from Maine to California and from Wisconsin to Florida, but the Southern States are not well represented for the reason that the registration area is as yet very limited there and at the present time embraces only a comparatively few cities. The New England States, New York, New Jersey, Pennsylvania, Ohio, Indiana, Illinois, Michigan, Wisconsin, and California contain the larger part of the small cities here considered, but other States, including Iowa, Kansas, Colorado, Minnesota, Kentucky, Maryland, Virginia, North Carolina, and Florida, are each represented by from one to three cities.

The mortality from consumption has been compiled for each of the 209 cities for the five-year period 1901–05. The original data for single years are to be found in the two census volumes,—"Mortality, 1900 to 1904" and "Mortality, 1905." The average annual mortality rates from consumption were found to vary from 426.7 per 100,000 of population in San Diego, Cal., to 21.4 in Leadville, Col., and the comparative rates, when arranged in the order of size, at once suggested that the differences might be largely accounted for by local differences in the age, sex, race, and nativity distribution of the populations, or by the peculiar physical or climatic features of the cities. Other pronounced factors, such as occupation, the presence in a city of a large institution for the care of the aged, hospitals for the insane, institutions for the treatment of consumptives, or a prison, or the reputation of the city as a health resort, have suggested possible explanations of the heavy mortality from consumption in certain cities. Obviously, the local registrar or health officer in a small city is in a position accurately to weigh and determine the importance of any or all of these factors which make for a high or low death-rate from consumption. By careful and detailed analysis of the population and the death returns the local registrar could often suggest why the death-rates from particular causes were high, and we have no doubt but that if the facts, when unfavorable, were properly presented, it would often be possible to secure immediate improvement in the local conditions responsible for the high mortality.

The general impression that tuberculosis is chiefly a disease of large cities is a false one, for it requires no very extended investigation to prove that, in proportion to population, a considerable number of our smaller towns and cities have relatively high death-rates from consumption, much higher, in fact, than the average for all cities, or for the larger cities combined, or for certain of the largest cities, such as New York, Philadelphia, and Chicago. The average death-rate from consumption in New York City during 1901–05 was 215.8 per 100,000 of population, but this average rate was exceeded in twenty-eight of the 209 small cities; in Philadelphia the average rate was 212.8, and this was exceeded in thirty-one of the small cities; and in Chicago the rate was 156.2, and this was exceeded in no less than eighty-five of the 209 cities here under consideration, and, in fact, the average rate for the 209 small cities combined was slightly higher than the Chicago rate.

The aggregate population exposed on the average one year to the risk of death during 1901–05 in the 209 small cities was 16,453,012. The average annual mortality rate from consumption was 157.6 per 100,000 of population, which compares with 191.5 for the population in the other larger cities of the registration area and 126.5 for the population in the rural parts of the registration States. The comparative figures are given in detail in the following summary table:—

MORTALITY FROM CONSUMPTION IN THE REGISTRATION AREA OF THE UNITED STATES, 1901–05.

Registration Area.	Population.	Mortality from Consumption.	
		Deaths.	Rates per 100,000.
The registration area	162,631,038	276,257	169.9
Cities with less than 30,000 population	16,453,012	25,927	157.6
Cities with more than 30,000 population	99,860,221	191,238	191.5
Rural part of registration States	46,317,805	58,572	126.5

In other words, the death-rate from consumption in the small cities was 21.0 per cent. higher than in the rural districts and 21.5 per cent. lower than in the cities with over 30,000 population. If the same average rate had prevailed in the small cities as in the rural districts, there would have been an aggregate saving or prolonging of 5,445 lives from death by consumption during the five years, or an average saving of 1,089 lives per year. On the other hand, if the same rate had prevailed in the small as in the large cities, there would have been an additional

loss of life over that actually reported of 5,527 during the five years, or an average of 1,115 per year. These illustrations show that the small cities, in the aggregate, in respect of their mortality rates from consumption stand about half-way between the cities with over 30,000 population and the rural districts.

There is abundant evidence that the mortality from consumption is abnormally high in certain rural districts, and it is an open question whether a death-rate from consumption above fifty per 100,000 of population is not excessive for either the city or country. In two of the small cities—Leadville, Col., and Plymouth, Pa.—the average annual rates during 1901–05 were less than fifty, or 21.4 and 29.4 respectively. For several other cities the rate fell below fifty during one or more of the years of the five-year period, and in no less than thirty of the 209 cities the average rate was less than 100.0 per 100,000 of population.

It is of interest to note that, if the average annual death-rate from consumption were 50.0 per 100,000 of population, there would be at the present time an annual saving or prolonging of approximately 3,540 lives in the 209 cities here under consideration, an annual saving of about 40,000 lives in the whole registration area, and an annual saving of well over 100,000 lives in the continental United States. I need hardly add that this possible ideal is certainly well worth all the labor and expense necessary for its attainment.

In the five-year period 1901–05 there has been a noticeable decline in the death-rate from consumption, when the cities are considered in the aggregate, and, as shown in the following table, the rate has declined from 170.0 in 1901 to 151.3 in 1905:—

MORTALITY FROM CONSUMPTION IN 209 SMALL CITIES IN THE REGISTRATION AREA OF THE UNITED STATES, 1901–05.

Year.	Population.	Number of Deaths.	Deaths per 100,000 of Population.
1901	3,166,949	5,383	170.0
1902	3,228,206	5,094	157.8
1903	3,291,585	4,864	147.8
1904	3,352,970	5,420	161.6
1905	3,413,302	5,166	151.3
1901–05	16,453,012	25,927	158.8

Considering the cities individually I find that 84 had a higher and 125 a lower death-rate from consumption in 1905 than in 1901. The general tendency of the rate seems, therefore, to have been downward, but the decline in the mortality from consumption may be expected to continue even more rapidly in the future, for undoubtedly the rate is at present at least three times as high as it should be.

The mortality from consumption in a particular locality is sometimes materially affected by the age distribution of the population. From the census of 1900 we learn that, while the death-rate from this cause was only 44.1 per 100,000 of population at ages under fifteen, the rate was 278.2 at ages sixty-five and over. Any abnormal age distribution of the population, such as a large or small proportion of persons at the very young or very old ages, would therefore materially affect the general death-rate from consumption. It is impossible to give details of the age distribution of the population of the small cities, as the facts were not reported for cities of less than 25,000 population in the census of 1900. I have, however, been able to calculate the percentage of the population at ages under five for all but eleven cities in Indiana. These original figures are to be found in Table 19 of "Vital Statistics," Part I, United States Census of 1900. I find that the average was 9.5 per cent. for the 209 cities in the aggregate, but that the percentages varied from 17.9 for Ironwood, Mich., and 16.5 for Berlin, N.H., to 6.2 for Ann Arbor, Mich., and 6.4 for Ithaca, N.Y. The low percentages of children in Ann Arbor and Ithaca suggest that the college population in those cities unduly increase the proportion of adults, and in consequence reduce the percentage of children to the total population. In cities such as Lafayette and Marion, Ind., and Leavenworth, Kan., the proportion of persons at advanced ages is unduly large, owing to the presence of institutions for the care and treatment of aged, disabled, and dependent soldiers, and among these the mortality rate from consumption is sufficiently high to materially affect the general rate, and I find that the mortality rate from consumption was 223.8 for Lafayette, Ind., 158.5 for Marion, Ind., and 153.3 for Leavenworth, Kan.* So far as I am able to learn, there are no institutions for the care of children of sufficient importance to materially affect the age distribution of the population of any of the 209 small cities here under consideration.

As regards sex, the available facts seem to indicate that consumption is, on the whole, somewhat more fatal among males than among females. There is good reason to believe, however, that the difference is not due to sex *per se*, but rather to other incidental factors, such as occupation,

* In the various branches of the National Home for Disabled Volunteer Soldiers the average annual death-rate from consumption per 100,000 of inmates was 625.5 during the five years 1900–04.

habits, etc. This assumption finds support in the fact that, while in cities the death-rates are exceptionally unfavorable to the males as compared with the females, in the rural districts the rates are actually higher among the females than among the males. It would carry me too far to go into this subject in any detail, and I will therefore pass it by with the remark that, so far as I have been able to judge, from a somewhat careful analysis of the statistics of the 209 small cities, the factor of sex distribution is one of minor importance in explaining the differences in the death-rates from consumption.

One of the most important factors to be considered in any comparative study of death-rates from consumption is race. This is a factor of special importance in nearly all Southern cities, where a large proportion of the total population are negroes, and in certain of the Northern cities—such as Leavenworth, Kan.; Steelton and Carlisle, Pa.; Montclair, Plainfield, Orange, Morristown, and Bridgeton, N.J.; New Albany and Richmond, Ind.; Ironton, Chillicothe, and Portsmouth, Ohio; Newport, R.I.; Jacksonville, Ill.; and Portsmouth, Ohio—the negro element is of sufficient importance to merit careful inquiry. In the following table the twenty-five cities with the largest proportion of negro population are given in the order of importance of the negro element, together with the general death-rates from consumption:—

TWENTY-FIVE SMALL CITIES WITH OVER FIVE PER CENT. OF NEGRO POPULATION IN 1900.

Cities.	Total Population, 1900.	Negro Population, 1900.	Per Cent. Negroes.	Death-rates from Consumption (1901–05).
Wilmington, N.C.	20,796	10,407	49.61	234.3
Petersburg, Va.	21,810	10,751	49.29	348.5
Lynchburg, Va.	18,891	8,254	43.69	252.0
Raleigh, N.C.	13,643	5,721	41.93	343.0
Annapolis, Md.	8,525	3,002	35.21	331.8
Key West, Fla.	17,114	5,562	32.50	300.9
Alexandria, Va.	14,528	4,533	31.20	259.2
Paducah, Ky.	19,446	5,814	29.90	327.4
Frederick, Md.	9,296	1,535	16.51	270.1
Leavenworth, Kan.	20,735	2,925	14.10	153.3
Steelton, Pa.	12,086	1,508	12.47	164.6
Carlisle, Pa.	9,626	1,148	11.93	183.7
Montclair, N.J.	13,962	1,344	9.63	123.3
Plainfield, N.J.	15,369	1,450	9.43	190.4
New Albany, Ind.	20,628	1,905	9.23	234.6
Orange, N.J.	24,141	1,903	7.88	289.9
Ironton, Ohio	11,868	924	7.79	246.1
Chillicothe, Ohio	12,976	986	7.60	182.5
Newport, R.I.	22,034	1,613	7.32	141.7
Morristown, N.J.	11,267	815	7.23	191.6
Jacksonville, Ill.	15,078	1,818	6.61	237.9
Richmond, Ind.	18,226	1,009	5.54	175.6
Portsmouth, Ohio	17,870	947	5.30	210.4
New Rochelle, N.Y.	14,720	777	5.28	94.9
Bridgeton, N.J.	13,913	701	5.04	160.1
Total for 209 cities	3,099,286	110,560	3.57	157.6

All but four of the twenty-five cities had a death-rate from consumption in excess of the average for the 209 cities combined, and the rate was considerably in excess in the nine Southern cities, in all of which the negro element constituted over fifteen per cent. of the total population in 1900. In Wilmington, N.C., and Lynchburg, Va., the negroes were nearly one-half of the total population, and in the nine Southern cities combined the negroes represented 38.6 per cent. of the total population.

From all the reliable data available it appears that consumption is much more prevalent and fatal among negroes than among the white population, and this is true in the North as well as in the South. According to the census of 1900 the average mortality rate from consumption among the negro population in the registration area was 485.4 per 100,000 of population against a rate of only 173.5 for the white

element of the population, or the mortality from consumption among the negroes was 180.0 per cent. in excess of that for the white population. The mortality from consumption among negroes is excessive at all ages, and, when the negro element forms any considerable part of the total population of a given locality, the mortality returns should make distinction of color or race and the death-rates should be separately calculated, otherwise the mortality record will be incomplete and the death-rates are likely to be of little value, if not positively misleading.

The vital statistics of the negro is a subject of great social importance, and there is no valid reason why much better and more determining data should not long since have been available to students of the subject. For three of the nine small cities with a large proportion of negro population the local health reports give the returns with distinction of color and principal causes of death. The State biennial health reports of North Carolina contain the data for Raleigh and Wilmington, and the city health reports give the same information for Petersburg, Va. As a rule, however, there is a lamentable lack of interest shown in this important subject.

In the Tenth Biennial Report of the State Board of Health of North Carolina (1903–04) we find the following statement (p. 87): "The scourge of the colored race remains tuberculosis. . . . The death-rate from consumption in the two races is as 1 to 2.6. With slight variation this proportion has been quite constant for years." In another portion of the report (p. 67) there is reprinted a letter which was sent by the Secretary of the Board of Health to all colored teachers in North Carolina, urging them to take an active part in the work of educating their race in the methods of prevention. From that letter I quote the following: "Pulmonary tuberculosis, or consumption, as it is commonly called, has come to be the bane of the colored race. It is the most fatal of all diseases to every race, but it is especially so among the colored people, being nearly three times as fatal to them as to the whites. It is, therefore, especially important to your people that every effort should be made to check the ravages of this dreadful disease. Being a contagious disease, it can be prevented by following carefully the directions which are fully set forth in the pamphlet on the subject issued by the State Board of Health, a copy of which is enclosed."

The local reports for Petersburg, Va., show that during 1901–05 the mortality rate from consumption for the negroes was 403.6 per 100,000 of population, and for the white population the rate was 247.8. Making due allowance for the presence in Petersburg of the Central Hospital for the Insane with an average population of about 1,000, among whom the mortality from consumption is presumably in excess of that in the

outside population, I still am convinced that the rate of 247.8 for the white population is far above what should constitute a normal rate. The local registrar or health officer could undoubtedly throw considerable light upon the facts if he were so disposed, but there is not a line of comment upon the facts in any of the reports which have come to my notice.

In Lynchburg, Va., the returns are not given with distinction of color, but in the report of the Board of Health for 1902 I find the following comment:—

"The mortality among the colored race continues to exceed that of the white by almost one-third, which we attribute to their mode of living and want of cleanliness. We have used our best efforts to induce them to lead a more cleanly and sanitary life, but they still disregard our injunctions and continue in filth and dissipation of all sorts. Many, however, live a cleanly, sanitary, and respectable life, and the superior healthfulness of this class is very manifest, and proves the importance of this mode of life.

"Most of the houses of the white population have been kept in good sanitary condition, but it is not so in regard to the colored population. Many of their homes are in an unsightly and unhealthy condition, which is manifested by the greater number of deaths among them than among the whites and the better class of their race."

There is abundant opportunity for valuable contributions to our knowledge of the vital statistics of the negro, and the local registrars are the proper authorities to perform this service. As already pointed out, several of the small Northern cities contain enough negroes to make it well worth while to report their mortality separately, and, until this is done, it will be impossible to judge fairly of the relative healthfulness of such cities as Montclair, Morristown, and Orange, N.J., Carlisle, Pa., New Albany, Ind., Ironton, Ohio, or Newport, R.I.

It is important also to know what effect a high death-rate from consumption among the negro element has upon the death-rate of the white population, and this question cannot be definitely answered without fuller information.*

* Of course there are other factors besides negro population that are favorable to a high mortality rate from consumption in some of the Southern cities. Low altitude, humid climate, made ground, and unhealthful occupations are met with in the South as well as in the North. In Key West, Fla., for example, in addition to the large negro population, there are a considerable number of Cubans who seem to be more subject to consumption than native Americans. In Key West, also, the cigar and cigarette industry is the leading employment, some two thousand or more wage-earners being employed. Cigar and cigarette makers are subject to a heavy mortality from consumption, and the death-rates from tuberculosis are excessive at all ages.

In Florida the State Board of Health has long been engaged in an anti-spitting cru-

The mortality from consumption among the Chinese, Japanese, and Indians, is also excessive as compared with the white population. According to the census of 1900 the rates per 100,000 of population were 656.8 for the Chinese, 239.6 for the Japanese, and 506.8 for the Indians in the registration area. Of course, these rates are unfavorably affected by the fact of an unduly high proportion of adults, but this unfavorable age distribution is a general characteristic, particularly of the Chinese and Japanese, in this country, and therefore operates to increase the general death-rate from consumption wherever these races are present in large numbers. The Chinese are of sufficient importance in certain cities in California to materially affect the local death-rates. In Fresno in 1900 the Chinese constituted 8.9 per cent. of the total population; in Sacramento, 3.6 per cent.; in San José, 2.6 per cent.; in Alameda, 1.8 per cent.; and in San Diego, 1.7 per cent. In addition to the comparatively large Chinese population the Japanese in Fresno formed 1.4 per cent. of the total population, and in Sacramento 1.2 per cent. In four of these California cities the mortality from consumption during 1901–05 was comparatively high, being 426.7 for San Diego, 285.9 for Sacramento, 261.8 for San José, and 251.4 for Fresno.

The local registrars in small cities where there are Chinese and Japanese in comparatively large numbers could render a valuable public and social service by reporting the mortality among these classes in detail by age, sex, and causes of death. In the monthly health reports of San Diego and Sacramento the total deaths are reported with distinction of the four races,—Caucasian, African, Mongolian, and Indian,—but no details are given under this classification for age, sex, or causes of death. Precedents have been established, however, in the larger cities of San Francisco and Los Angeles, where the annual health reports show the principal causes of death with distinction of race. In San Francisco

made. In the Sixteenth Annual Report of that body (1905) the statement was made that "the rule is generally adopted in the cigar factories in Key West that spitting on the floor, or in any place but in a cuspidor, warrants a discharge of the operator. Each table in the cigar manufacturing room is supplied with a cuspidor which the cigar maker is compelled to use. The Ruy Lopes factory at Key West was the first to adopt this cleanly method, in compliance with the State Board's request, and the practice is now universally adopted by all other manufacturers. The innovation upon former uncleanly methods of promiscuous expectoration on the floors was resisted at first, but a little firmness, combined with kindly persuasion and explanation, overcame all objections, and it is now thought that the operatives themselves would be decidedly unwilling to return to former uncleanly habits."

These facts are of interest as indicating the practical utility of local statistics of sickness and mortality in any similar effort to bring about sanitary reforms in any particular industry or locality. Employers and employees are usually open to suggestions for sanitary reforms if the suggestions are accompanied by reliable facts which indicate the strong probability of improved health when the reforms shall have been effected.

during the year 1905 there were 118 deaths from consumption among the Chinese, or equivalent to a rate of 1,207 per 100,000 of population, or over 12 per 1,000 of population, assuming that the Chinese were of the same proportionate strength in the population in 1905 as in 1900 and that the total population increased at the same rate during 1900–05 as during the intercensal decade 1890–1900. In Los Angeles during 1901–05 there were 101 deaths from consumption among the Chinese and Japanese, these races not being separated in the returns. We have no way of determining the exact number of the Chinese and Japanese exposed on the average one year to the risk of death, but, if we assume that the percentage of these elements to the total population in Los Angeles during 1901–05 remained approximately the same as in 1900, the death-rate from consumption was over 1,100 per 100,000, or more than 11 per 1,000 of population. It is of the utmost importance to know with more certainty what the death-rates from consumption is among the Chinese and Japanese in this country. If the actual conditions are as bad as they appear to be from the fragmentary data now available, it behooves the health or other responsible authorities to make the facts known, so that drastic measures may be taken to restrict the spread of the disease from these danger spots and so far as possible to eradicate the sources of infection by a more rigid enforcement of the health and sanitary laws among these elements of the population.

Among the foreign born the mortality from consumption is often very heavy, and the rate varies considerably among the different nativities. According to the census of 1900, at ages 15–44, the average rate per 100,000 of population was 428.0 for persons of Irish birth, 235.2 for Bohemians, 233.7 for Scandinavians, 220.6 for the French, 205.9 for Germans, 201.1 for the Scotch, and 199.7 for Canadians. For the white population of native birth the rate was only 162.5 at ages 15–44. It would carry me too far to go into the subject of nativity in its relation to consumption in any detail, but the facts stated indicate that in any locality with a large proportion of persons of foreign birth the crude death-rate from consumption is likely to be considerably higher than in another locality, similar in other respects, but with a population practically all of native birth.*

The physical characteristics of a locality often exert a considerable influence upon the general death-rate, and, as a rule, the death-rate from

* The foreign-born element in the total population ranged from 1.8 per cent. in Carlisle, Pa., to 58.4 per cent. in Chicopee, Mass. There were eleven cities with more than 40.0 per cent. of foreign-born population, and ninety-seven with more than 20 per cent. In any valuable analysis of the mortality from consumption in its relation to nativity it would be necessary to know the relative importance of the various nativities in any particular locality. These facts are not obtainable in the census of 1900 for cities of less than 25,000 population.

certain causes of death, such as malaria, typhoid fever, consumption, and respiratory diseases, reflect more clearly than others the influence upon health of climate, latitude, and topography, including altitude, natural drainage, character of the soil, etc. Obviously, it would require more time and space than I have at my command to discuss all of these factors as they are illustrated in the mortality from consumption in the 209 cities with which I am at present concerned. Thanks to the good work of the United States Geological Survey and the Bureau of Soils of the Department of Agriculture, the facts of topography are rapidly becoming available, and the soil survey reports especially should be of great value to sanitarians, health officials, and physicians.

I shall attempt here to deal briefly with only one topographic fact in its relation to the mortality from consumption. We now know with approximate accuracy the altitude of practically every place of importance in the United States, and the facts are available in the Dictionary of Altitudes, compiled by Mr. Henry Gannett, United States Geographer. When more than one elevation is given, I have taken the average as probably best representing the true altitude of the city as a whole. For Ithaca, N.Y., for example, four observations are reported in the Dictionary of Altitudes. The extremes are 381 feet at the water surface of Cayuga Lake and 836 feet at the Weather Bureau, which is the Civil Engineering Building on the Cornell University Campus. The altitude, or elevation, is given for two other intermediate points, and the average of the four elevations is 611 feet, which perhaps represents as nearly as possible the average altitude of the city as a whole, a considerable part of which is built on east, south, and west hills. For certain New England *towns* the elevation given for the principal city in the town has been taken as the best approximation for the town as a whole. In considering this factor of altitude, I have discarded the nine cities with over fifteen per cent. of negro population, and arranged the remaining 200 cities in eleven groups, the first group including cities of less than 100 feet elevation, the second of from 100 to 199 feet, the third of from 200 to 299 feet, and so on to the last group, which includes all the cities at an altitude of 1,000 feet or more. The following table gives the facts in detail, including a summary statement of the mortality in three larger groups of cities, those with altitudes of less than 500 feet, with altitudes of from 500 to 1,000 feet, and with altitudes over 1,000 feet:—

MORTALITY FROM CONSUMPTION IN 200 SMALL CITIES OF THE REGISTRATION AREA, 1901–05.

(*Cities Arranged by Altitude.*)

Altitude in Feet.	Number of Cities.	Aggregate Population.	Number of Deaths.	Deaths per 100,000.
Under 100 feet	53	4,400,522	7,452	169.4
100–199	18	1,568,465	2,657	169.4
200–299	14	981,723	1,604	163.4
300–399	5	342,391	560	163.6
400–499	16	971,312	1,555	160.1
500–599	25	2,121,306	2,943	138.8
600–699	20	1,463,528	1,988	135.8
700–799	16	1,127,495	1,537	136.3
800–899	10	984,112	1,299	132.0
900–999	6	519,232	664	127.9
1,000 and over	17	1,215,641	1,434	117.9
Under 500 ft.	106	8,264,413	13,828	167.3
500–999	77	6,215,673	8,431	135.7
1,000 and over	17	1,215,641	1,434	117.9
Total	200	15,695,727	23,693	151.0

The statistics show that there is a close relation between altitude and mortality from consumption, and the death-rates decline with quite remarkable regularity as the altitude increases. There are many disturbing factors, such as health resorts, occupations, etc., which operate to offset the favorable influence of altitude, but notwithstanding these the table shows that the effect of elevation is strong enough to make itself felt in the death-rates when the populations are sufficiently large to give a fair average. Some cities with comparatively high altitudes have relatively high mortality rates from consumption, but in such cases there is always a disturbing factor of sufficient importance to outweigh the favorable effect of altitude, and it is safe to assume that the rates would be higher if the cities were at appreciably lower altitudes.

The effect of altitude upon the mortality from consumption is perhaps best shown by grouping the cities into two equal or nearly equal divisions in such States as are sufficiently well represented to make such a classification possible. The result of this method is shown in the following table:—

MORTALITY FROM CONSUMPTION IN SMALL CITIES, 1901–05.

(Cities Arranged by Altitude and by States.)

States.	Altitude.	Number of Cities.	Population.	Number of Deaths.	Deaths per 100,000 of Population.
Connecticut	Under 100 ft.	9	735,935	1,230	167.1
	Over 100 ft.	7	429,385	667	155.3
Indiana	Under 700 ft.	10	685,679	1,304	190.2
	Over 700 ft.	9	749,305	1,199	160.0
Massachusetts	Under 100 ft.	20	1,602,356	2,280	142.3
	Over 100 ft.	17	1,134,418	1,672	147.4
Michigan	Under 750 ft.	9	595,017	625	105.0
	Over 750 ft.	8	609,001	586	96.2
New Hampshire	Under 250 ft.	4	291,375	507	174.0
	Over 250 ft.	4	242,890	319	131.3
New Jersey	Under 100 ft.	5	407,663	560	137.4
	Over 100 ft.	6	490,272	928	189.3
New York	Under 450 ft.	14	1,292,870	2,302	178.1
	Over 450 ft.	14	1,071,727	1,199	111.9
Ohio	Under 700 ft.	8	594,100	986	166.0
	Over 700 ft.	5	428,412	611	142.6
Pennsylvania	Under 600 ft.	8	656,146	977	148.9
	Over 600 ft.	7	477,978	384	80.3
Wisconsin	Under 700 ft.	3	246,152	308	125.1
	Over 700 ft.	4	352,078	419	119.0

This table requires no extended comment. It is quite clearly shown that altitude is an important factor in any consideration of the comparative mortality from consumption in small cities. The differences in the rates for cities of low as compared with cities of relatively high elevations are too pronounced to admit of any doubt as to the salutary effect of high altitude, and the statistics confirm the general opinion that low ground and a generally damp or humid atmosphere increase the liability to consumption, while high ground and a generally dry and rarefied atmosphere are favorable to a low mortality from tuberculosis. In Massachusetts and New Jersey the rates for the cities located at relatively high altitudes are higher than for the cities of low elevation, but these apparent exceptions are the result of other important factors, such as occupation, which affect the rates sufficiently to more than balance the favorable effect of the higher elevations.

That consumption is a frequent cause of death in institutions, such as almshouses, insane asylums, and prisons, is a fact well known to all who are familiar with the mortality returns of such institutions. During a twelve-year period the average annual mortality from consumption in four representative State hospitals for the insane * was 805.0 per 100,000 of inmates exposed on the average one year. These statistics show a progressive improvement in the sanitary conditions, however, and the rate during the last six years of the period was 701.3 as compared with 923.6 during the first six years.

In seven representative State prisons † the mortality rate from consumption during twelve years averaged 605.0 per 100,000 of inmates. In these institutions, in the aggregate, the rate declined from 760.3 during the first six years to 549.8 during the last six years. Whenever a large almshouse, prison, insane asylum, soldiers' home, or other institution for the more or less permanent care or treatment of the adult and aged, is found in a small city, the general death-rate from consumption is almost certain to be appreciably affected by its presence.

In Ogdensburg, N.Y., there is a large State hospital for the insane, and the death-rate from consumption for that city was 291.3 during 1901–05; in Danvers, Mass., there is also a large hospital for the insane, and the rate was 284.6; in Norristown, Pa., there is located a State hospital for the insane, with a yearly average of nearly 2,500 patients, and the rate was 275.6; in Middletown, Conn., there is a State hospital for the insane, and the rate was 254.3; and in Jacksonville, Ill., which contains the Central Hospital for the Insane, with an average of about 1,500 patients, the general death-rate from consumption was 237.9. We might go further with our illustrations, but they will occur to any one, and those given will suffice for the present purpose.

It is self-evident that, if a city contains a large hospital for the special treatment of consumptives or a general hospital to which are attracted a considerable number of non-resident, consumptive patients, the death-rate from consumption is likely to be appreciably affected. So far as I have been able to discover, there are no such institutions in the 209 cities with which I am dealing, or at least there is none of sufficient importance to materially affect either the general death-rate or the death-rate from consumption. There are, however, certain cities which, because of their fame as health resorts, attract invalids, including consumptives, from all parts of the United States. Among these are San Diego, San José and Sacramento, Cal., Pueblo, Col., and Saratoga

* New Jersey State Hospital, Central Hospital, Illinois, State Hospital, Utica, N.Y., State Hospital, Wisconsin, 1891–1902.

† Sacramento, Cal., Joliet, Ill., Charlestown, Mass., Philadelphia, Pa., Columbus, Ohio, Ossining, N.Y., and Clinton State Prison, New York, 1891–1902.

Springs, N.Y. All of these cities have excessively high mortality rates from consumption. The rates in the California cities are also unfavorably affected by the Chinese element, as has previously been pointed out, and, largely as a result of the two factors, San Diego heads the list of the 209 small cities, with a rate of 426.7. Pueblo is fourth, with a rate of 338.1, and it is second, if we exclude the two cities of Petersburg, Va., and Raleigh, N.C., where the negro element is a predominating factor. The high rate of 211.5 for Saratoga Springs is clearly the effect of the large invalid non-resident population.

It would materially increase our knowledge and serve a very practical and useful purpose if the local registrars would make careful note of the mortality by causes in the important institutions within their respective jurisdictions, and in cities like Pueblo, Col., and Saratoga Springs, N.Y., the deaths of the non-resident population should be distinguished from the deaths of the resident population. It would be desirable to have this distinction made in all cities, but it is of special importance in cities where there are large numbers of non-resident invalid persons. There can be no question of doubt but that the presence of a large number of pulmonary invalids scattered throughout a city, itself normally comparatively free from the disease, must constitute a menace to the health of the resident population. There can be no doubt but that there is a gradual spread of infection where pulmonary invalids are permitted to live in boarding-houses or hotels without a most careful medical supervision, and there is probably no stronger argument in favor of sanatoria for the treatment of incipient or advanced cases of consumption than the fact that without supervision and control the disease is spread from the infected to the uninfected, and localities formerly almost free from consumption finally become a menace to the health of the local population. The importance of these facts can only become generally known by a more adequate presentation and analysis of the mortality by the local registrars.

Certain occupations have a marked effect upon the health and mortality of those employed therein. This general fact was established long ago, but much still remains to be done before sufficient data will be available to make it possible to get at the real facts of health and longevity as affected by the various trades and occupations. There is a dearth of material in this country along these lines, and this is particularly unfortunate, because we cannot be guided by English or European experience in these matters, for the conditions here are generally very different from those which obtain in the older countries. There is not a single city in the United States which has published trade mortality statistics in the excellent manner in which this has been done in the health reports of Blackburn and Sheffield, England. There are

some fragmentary data available in certain local reports of this country, of which I may mention the Registration Reports of Rhode Island and the State Health Reports of Vermont. But, generally speaking, no emphasis whatever has been placed upon this important phase of vital statistics in this country, and this is the more remarkable because of the many excellent opportunities for good work along these lines in many of our small cities where important and more or less health-injurious trades are centred.* The information relating to mortality by occupations compiled in the Eleventh and Twelfth Censuses of the United States are good so far as they go, but they do not go far enough to serve the most useful and practical purposes. The terms are too general, and the groupings are either too large or too indefinite to permit of accurate conclusions as to the relative healthfulness of specific employments. We cannot expect a census to yield the most important results along these lines of inquiry. The census should give the facts as to the number of employees, but the local registrars or health officers must furnish the necessary details as to age, sex, and causes of death among the employees in at least the more important industries centred in their respective cities.

Of all the diseases affected by occupation, the one most generally affected is consumption. This disease is more common among employees in dusty trades than in trades free from dust; and it is more frequent among persons engaged in sedentary employments, such as book-keeping, than among persons, like farmers, who live an outdoor life of manual labor. There seems to be little doubt but that the mortality rate from consumption in small cities is materially affected by certain predisposing occupations which, in several instances, are sufficiently prominent to be an important factor in the mortality. The mortality rate from consumption in Orange, N.J., was 289.9 as compared with the average of 151.0 for the 200 cities (excluding the nine cities with large negro populations), or the rate of Orange represented an ex-

* In the introduction to that very useful work, "The Hygiene, Diseases, and Mortality of Occupations," Dr. J. T. Arlidge, in reviewing the history and sources of the materials which he had been able to gather, remarks: "One source of the information sought might fairly be looked for in the reports issued by the medical officers of health in the various towns, but, so far as these documents have fallen under my notice, they have proved barren. It is, to my mind, an indication that the importance of noting industrial diseases and estimating their influence on the public health and mortality has not as yet been recognised. The reports of Dr. Sinclair White, formerly medical officer of health at Sheffield, constituted a noteworthy exception. He presented special memoranda on the health of Sheffield artisans. His successor in that town, Dr. Theodore Thomson, followed his example during the time he held office." Dr. Arlidge's book was published in 1892, and the good work at Blackburn was only in its beginning. The Blackburn reports have proven to be for the cotton-mill operatives what the Sheffield reports have been for the file and cutlery artisans. Both have served a very useful purpose in helping to bring about notable improvements in the conditions of employment, and these in turn have resulted in a reduction of the death-rates compared with those which formerly prevailed.

cess over the average of 138.9 per 100,000 of population. A considerable part of this excess was undoubtedly the result of employment in the felt-hat industry. The making of felt hats is generally recognized to be a health-injurious trade, and the mortality from consumption and respiratory diseases among hatters is high at all ages. In 1905 there were 1,379 employees engaged in the felt-hat industry in Orange,—a number sufficiently large in proportion to the total population to quite materially affect the local death-rate.

In Barre, Vt., the average annual mortality rate from consumption during 1901–05 was 205.4 per 100,000 of population, or an excess above the average of 54.4. This city is at an altitude of 515 feet in the hill section of Northern Vermont, where the general health and sanitary conditions are excellent. But the stone-cutting industry is centred at Barre, and in this industry there is an extraordinary prevalence of consumption. The biennial reports of the State Board of Health of Vermont show that in Washington County during the six years 1900–05 there were 137 deaths of stone-cutters, 66, or 46.7 per cent. of which, were due to consumption, and 20, or 15.3 per cent., were due to respiratory diseases. We do not know how many persons are employed at stone-cutting in Barre, but it is the principal employment, and the local physicians distinctly recognize what they designate as "stone-cutters' consumption."

Amsterdam, Cohoes, and Middletown, N.Y., are centres for the manufacture of hosiery and knit goods, and it would be an important addition to our knowledge of the vital statistics of knitting-mill employees if the facts were available, showing their mortality in detail.

In several other small cities in New England, New York, New Jersey, and Pennsylvania, textile trades are of local importance. In New England the cotton mills employ thousands of men and women; in Jamestown, N.Y., nearly 2,000 are employed in worsted mills; and in Norristown, Pa., nearly 1,500 are employed in knitting and woollen mills. The health officers or local registrars in these cities should make themselves familiar with the health reports of Blackburn, England, which for nearly twenty years have contained the detail mortality statistics of cotton-mill operatives. That the Blackburn returns have been of great benefit is testified to by employers, employees, factory inspectors, and all those who are familiar with British factory legislation and the reduction in mortality effected thereby, particularly among cotton weavers.

In the coal mining towns and cities and in the metal mining centres detailed statistics of mortality from diseases among miners are urgently needed to supplement the data showing deaths by accident. Among the 209 small cities there are several which contain a large proportion of

coal or metal miners. There seems to be a considerable difference in the mortality from consumption among coal miners as compared with metal miners, including iron, copper, lead and zinc, and the precious metals. This is what we would theoretically expect, but it is one thing to know, in a general way, that there is a difference, and it is quite another and more important thing to know exactly what the difference is from reliable local returns. The registrars or health officers in such cities as Mahanoy City, Carbondale, and Hazleton, Pa., and Iron Mountain, Ironwood, and Ishpeming, Mich., could render an extremely valuable service along this line if only they were so disposed.

In nearly all of the small cities there are one or more occupations for which additional information as to health conditions and mortality would serve a very useful and practical purpose. For example, there are trolley systems in nearly all of the cities, and it is of importance to know the relative mortality from consumption among the street-car conductors and motormen compared with the general population of approximately the same ages. From the viewpoint of public hygiene this information would serve a highly useful purpose.

Among other important occupations met with in all cities, and with more or less excessive death-rates from consumption, I may mention bakers and printers. It is a matter of the greatest concern to the bread and cake eating public that the bakeries be made as cleanly, well ventilated, and generally healthful as possible. If the bakers in any given city are dying from consumption in such numbers as to indicate bad conditions in their bake-shops, the facts should be made known, and it is the imperative duty of the registrars of vital statistics to see to it that the relation between cause and effect is made public, so that proper pressure may be brought to bear to bring about the necessary improvements. Health officers should be co-workers and in entire harmony with the factory inspectors in these matters.

That the mortality from consumption among printers is excessive is quite generally known, but, if there were more reliable statistics of their mortality by causes and by age, the data would serve a useful purpose in any effort, by legislation or otherwise, to improve the conditions in printing establishments. In this connection we may call attention to a note on the health of printers in the *Bulletin of the Department of Labor* of New York for June, 1907. A special report on the "Health of Printers" will appear also in the forthcoming Twenty-fourth Annual Report of the Bureau of Labor Statistics of New York.

I do not need to add further details at the present time. I think that the facts presented are sufficient to prove that the opportunities for useful contributions to our knowledge of vital statistics which are open to health officers and registrars in the small cities of this country are

quite as numerous and important as in the large cities. What are needed most at the present time are men with the ambition and talent, patience and industry, to dig out the facts from the mines of information which lie everywhere about them.

Addison, in his remarkable essay entitled "The Visions of Mirzah," depicted the span of life from birth to death, as a more or less dilapidated bridge leading across a chasm through which raged a turbulent and destructive tide. The crossing of this bridge was represented to be at best a hazardous undertaking, and, of the many who found themselves on the approach, comparatively few succeeded in reaching the far extremity. We may carry this simile a little farther, and liken the registrars of vital statistics to the life-bridge inspectors. It is their peculiar privilege and imperative duty to make careful and diligent inquiry into all the facts of mortality, and to point out, when necessary, the weak points and hidden pitfalls in the bridge which require strengthening and repair. It is their business to see to it that as many as possible of all those who once get on the bridge may succeed in crossing it safely. Their work will be successful only in so far as they report the facts of mortality in sufficient detail to make possible the accurate location of the places which require repair.

I trust that I have succeeded in indicating a few of the ways in which good and much-needed work can be performed by the collectors and custodians of death certificates in our small cities. The work to be done requires that the position of health officer or registrar of vital statistics shall be a more permanent one than is possible if it is to continue to be the football of politics. It is difficult to imagine a more important work than that intrusted to health officers. Upon their efficiency largely depends the health of the community, than which nothing is of greater importance. When we awake to a full realization of this fact, we may hope to see the health officers of this country holding their positions solely because of their fitness, and then, and not until then, can we expect to get the best information from the local mortality records, and be in a position more fully to understand all the complicated facts relating to the health and longevity of our population through all its progress over the hundred more or less broken arches of the bridge of human life.

TABLE I.

MORTALITY FROM CONSUMPTION IN 209 SMALL CITIES OF THE UNITED STATES, 1901–05.

Cities.	Population (1901–05).	Deaths from Consumption.		Deaths from All Causes.		Per Cent. of Total Deaths due to Consumption.
		Number.	Rates. per 100,000 Population.	Number.	Rates. per 1,000 Population.	
Adams (town), Mass.	59,723	100	167.4	998	16.7	10.0
Alameda, Cal.	90,270	114	126.3	1,235	13.7	9.2
Alexandria, Va.	72,925	189	259.2	1,616	22.2	11.7
Amesbury (town), Mass.	45,469	81	178.1	745	16.4	10.9
Amsterdam, N.Y.	115,381	170	147.3	1,784	15.5	9.5
Anderson, Ind.	115,050	200	173.8	1,543	13.4	13.0
Ann Arbor, Mich.	72,881	71	97.4	1,116	15.3	6.4
Annapolis, Md.	44,005	146	331.8	921	20.9	15.9
Ansonia, Conn.	66,915	103	153.9	949	14.2	10.8
Appleton, Wis.	81,170	94	115.8	932	11.5	10.1
Arlington (town), Mass.	46,210	60	129.8	557	12.1	10.7
Ashtabula, Ohio	70,910	80	112.8	1,074	15.1	7.5
Attleboro (town), Mass.	60,773	89	146.4	811	13.3	11.0
Augusta, Me.	60,155	97	161.3	1,428	23.7	6.8
Aurora, Ill.	127,425	142	111.4	1,674	13.1	8.5
Bangor, Me.	113,375	197	173.8	2,026	17.9	9.7
Barre, Vt.	48,690	100	205.4	697	14.3	14.4
Bath, Me.	55,010	85	154.5	825	15.0	10.3
Battle Creek, Mich.	106,501	125	117.4	1,695	15 9	7.4
Bellaire, Ohio	49,560	77	155.4	975	19.7	7.9
Belleville, Ill.	90,600	126	139.1	1,544	17.0	8.2
Beloit, Wis.	59,435	85	143.0	787	13.2	10.8
Bennington, Vt.	42,625	57	133.7	658	15.4	8.7
Berlin, N.H.	52,170	44	84.3	759	14.5	5.8
Beverly, Mass.	73,435	101	137.5	1,057	14.4	9.5
Biddeford, Me.	83,275	154	184.9	1,587	19.1	9.7
Bridgeton, N.J.	68,700	110	160.1	1,007	14.7	10.9
Bristol (town), Conn.	51,605	58	112.4	782	15.2	7.4
Brookline (town), Mass.	110,176	89	80.8	1,650	10.9	7.4
Burlington, Iowa	122,353	166	135.7	1,664	13.6	10.0
Burlington, Vt.	99,275	131	132.0	1,828	18.4	7.2
Carbondale, Pa.	71,280	61	85.6	1,261	17.7	4.8
Carlisle, Pa.	51,145	94	183.7	802	15.7	11.7
Central Falls, R.I.	94,670	146	154.2	1,570	16.6	9.3
Chicopee, Mass.	98,905	153	154.7	1,837	18.6	8.3
Chillicothe, Ohio	67,415	123	182.5	1,048	15.5	11.8
Clinton (town), Mass.	66,652	72	108.0	1,062	15.9	6.8
Cohoes, N.Y.	120,006	265	220.8	2,345	19.5	11.3
Columbia, Pa.	64,310	63	98.0	930	14.5	6.8
Columbus, Ind.	42,765	101	236.2	670	15.7	15.0

TABLE I.—*Continued.*

Cities.	Population (1901–05).	Deaths from Consumption.		Deaths from all Causes.		Per Cent. of Total Deaths due to Consumption.
		Number.	Rates. per 100,000 Population.	Number.	Rates. per 1,000 Population.	
Concord, N.H.	102,105	147	144.0	1,740	17.0	8.4
Corning, N.Y.	62,433	75	120.1	909	14.6	8.2
Cortland, N.Y.	51,610	38	73.6	637	12.3	6.0
Danbury (town), Conn.	97,370	181	185.9	1,615	16.6	11.2
Danvers (town), Mass.	44,271	126	284.6	1,205	27.2	10.5
Decatur, Ill.	110,787	153	138.1	1,528	13.8	10.0
Dover, N.H.	66,665	110	165.0	1,150	17.3	9.5
Dubois, Pa.	51,720	28	54.1	747	14.4	3.8
Dunkirk, N.Y.	68,821	56	81.4	1,105	16.1	5.1
Eau Claire, Wis.	91,245	120	131.5	1,033	11.3	11.6
Elkhart, Ind.	81,775	117	143.1	1,020	12.5	11.4
Elwood, Ind.	80,455	87	108.1	827	10.3	10.5
Escanaba, Mich.	53,552	90	166.2	1,003	18.7	8.9
Everett, Mass.	136,005	221	162.5	1,841	13.5	12.0
Findlay, Ohio	88,065	134	152.2	1,091	12.4	12.3
Flint, Mich.	72,692	67	92.0	1,020	14.0	6.6
Framingham (town), Mass.	57,246	58	101.3	850	14.8	6.9
Frederick, Md.	48,130	130	270.1	1,059	22.0	12.3
Fresno, Cal.	64,825	163	251.4	1,295	20.0	12.6
Gardner (town), Mass.	57,660	73	126.6	865	15.0	8.4
Geneva, N.Y.	57,346	48	83.7	808	14.1	5.9
Glens Falls, N.Y.	69,173	97	140.2	1,058	15.3	9.2
Gloucester, Mass.	130,275	187	143.5	2,274	17.5	8.2
Gloversville, N.Y.	92,430	100	108.2	1,283	13.9	7.8
Green Bay, Wis.	105,930	129	121.8	1,466	13.8	8.8
Greenwich (town), Conn.	63,920	74	115.8	1,026	16.1	7.2
Hamilton, Ohio	128,960	192	148.9	1,850	14.3	10.4
Hammond, Ind.	71,330	77	107.9	1,041	14.6	7.4
Harrison, N.J.	59,658	106	177.7	1,083	18.2	9.8
Hazleton, Pa.	75,285	67	89.0	1,095	14.5	6.1
Hudson, N.Y.	50,146	92	183.5	948	18.9	9.7
Huntington, Ind.	50,630	84	165.9	678	13.4	12.4
Hyde Park (town), Mass.	70,016	105	150.0	918	13.1	11.5
Iron Mountain, Mich.	43,748	47	107.4	637	14.6	7.4
Ironton, Ohio	60,135	148	246.1	1,003	16.7	14.7
Ironwood, Mich.	49,701	38	76.5	707	14.2	5.4
Ishpeming, Mich.	60,155	78	129.7	815	13.5	9.6
Ithaca, N.Y.	69,760	91	130.4	1,087	15.6	8.4
Jackson, Mich.	126,350	128	101.3	1,826	14.5	7.0
Jacksonville, Ill.	78,600	187	237.9	1,721	21.9	10.9
Jamestown, N.Y.	123,796	134	108.2	1,485	12.0	9.0
Jeffersonville, Ind.	54,035	138	255.4	1,063	19.7	13.0
Johnstown, N.Y.	49,555	52	104.9	661	13.3	7.9
Keene, N.H.	48,405	60	124.0	738	15.2	8.2
Key West, Fla.	95,720	288	300.9	2,079	21.7	13.9

TABLE I.—*Continued.*

Cities.	Population (1901–05).	Deaths from Consumption.		Deaths from all Causes.		Per Cent. of Total Deaths due to Consumption.
		Number.	Rates. per 100,000 Population.	Number.	Rates. per 1,000 Population.	
Kingston, N.Y.	125,300	242	193.1	2,204	17.6	11.0
Kokomo, Ind.	56,570	114	201.5	896	15.8	12.7
Laconia, N.H.	40,210	68	169.1	744	18.5	9.1
Lafayette, Ind.	93,385	209	223.8	1,656	17.7	12.6
Lansing, Mich.	96,640	55	56.9	1,170	12.1	4.7
Leadville, Col.	65,380	14	21.4	1,149	17.6	1.2
Leavenworth, Kan.	111,549	171	153.3	1,646	14.8	10.4
Leominster (town), Mass.	67,675	87	128.6	870	12.9	10.0
Lima, Ohio	126,127	198	157.0	1,778	14.1	11.1
Lockport, N.Y.	85,443	116	135.8	1,329	15.6	8.7
Logansport, Ind.	85,340	161	188.7	1,491	17.5	10.8
Lynchburg, Va.	106,750	269	252.0	2,199	20.6	12.2
Madison, Wis.	110,228	120	108.9	1,172	10.6	10.2
Mahanoy City, Pa.	70,850	40	56.3	1,549	21.9	2.6
Manchester (town), Conn.	56,575	84	148.5	684	12.1	12.2
Manitowoc, Wis.	61,768	97	157.0	813	13.2	11.9
Mankato, Minn.	54,183	75	138.4	743	13.7	10.1
Marietta, Ohio	74,360	85	114.3	992	13.3	8.6
Marinette, Wis.	78,454	82	104.5	917	11.7	8.9
Marion, Ind.	103,491	164	158.5	1,363	13.2	12.0
Marlboro, Mass.	69,435	101	145.5	996	14.3	10.2
Marquette, Mich.	52,565	75	142.7	798	15.2	9.4
Massillon, Ohio	62,495	56	89.6	748	12.0	7.5
Meadville, Pa.	54.618	43	78.7	783	14.3	5.5
Medford, Mass.	95,543	111	116.2	1,193	12.5	9.3
Melrose, Mass.	68,806	84	122.1	875	12.7	9.6
Menominee, Mich.	57,634	52	90.2	749	13.0	6.9
Michigan City, Ind.	80,355	99	123.2	1,044	13.0	9.5
Middletown, N.Y.	76,090	147	193.2	1,465	19.3	10.0
Middletown, Ohio	46,300	78	168.5	595	12.9	13.1
Middletown (town), Conn.	90,850	231	254.3	1,850	20.4	12.5
Milford (town), Mass.	59,065	81	137.1	872	14.8	9.3
Millville, N.J.	56,816	77	135.5	820	14.4	9.4
Montclair, N.J.	77,031	95	123.3	1,353	17.6	7.0
Morristown, N.J.	58,970	113	191.6	1,090	18.5	10.4
Mt. Carmel, Pa.	73,290	59	80.5	1,330	18.1	4.4
Mt. Vernon, N.Y.	117,243	135	115.1	1,659	14.2	8.1
Muncie, Ind.	120,969	196	162.0	1,830	15.1	10.7
Muscatine, Ia.	73,405	60	81.7	959	13.1	6.2
Muskegon, Mich.	104,385	106	101.5	1,308	12.5	8.1
Nashua, N.H.	126,375	206	162.2	1,998	15.8	10.3
Natick (town), Mass.	47,801	75	156.9	704	14.7	10 7
Naugatuck, Conn.	59,185	99	167.3	818	13.8	12.1
New Albany, Ind.	103,140	242	234.6	1,786	17.3	13.6
New Brunswick, N.J.	109,408	181	165.4	2,018	18.4	9.0

TABLE I.—*Continued.*

Cities.	Population (1901–05).	Deaths from Consumption.		Deaths from All Causes.		Per Cent. of Total Deaths due to Consumption.
		Number.	Rates. per 100,000 Population.	Number.	Rates. per 1,000 Population.	
New London, Conn.	93,425	186	199.1	1,795	19.2	10.4
New Rochelle, N.Y.	90,598	86	94.9	1,226	13.5	7.0
Newark, Ohio	96,620	136	140.8	1,409	14.6	9.6
Newburg, N.Y.	128,840	286	221.9	2,408	18.7	11.9
Newburyport, Mass.	72,978	111	152.1	1,392	19.1	8.0
Newport, Ky.	146,575	256	174.7	2,319	15.8	11.1
Newport, R.I.	119,996	170	141.7	1,909	15.9	8.9
Niagara Falls, N.Y.	118,210	118	99.8	1,918	16.2	6.2
Norristown, Pa.	115,030	317	275.6	2,819	24.5	11.2
North Adams, Mass.	114,850	166	144.5	1,794	15.6	9.3
Northampton, Mass.	97,155	125	128.7	1,548	15.9	8.1
Norwalk (town) Conn.	102,945	157	152.5	1,580	15.3	10.0
Norwich (town), Conn.	125,570	202	160.9	2,220	17.7	9.1
Ogdensburg, N.Y.	73,806	215	291.3	1,720	23.3	12.5
Olean, N.Y.	49,158	27	54.9	565	11.5	4.8
Orange, N.J.	126,585	367	289.9	2,551	20.2	14.4
Ottawa, Ill.	54,440	67	123.1	710	13.0	9.5
Owosso, Mich.	45,162	37	81.9	441	9.8	8.4
Paducah, Ky.	104,775	343	327.4	2,269	21.7	15.1
Peabody (town), Mass.	62,340	85	136.3	876	14.1	9.7
Peekskill, N.Y.	60,313	101	167.5	1,069	17.7	9.5
Perth Amboy, N.J.	113,081	86	76.1	1,463	12.9	5.9
Peru, Ind.	54,885	65	118.4	649	11.8	10.0
Petersburg, Va.	109,050	381	348.5	2,877	26.4	13.2
Phillipsburg, N.J.	60,160	63	104.7	781	13.0	8.1
Pittsfield, Mass.	118,535	147	124.0	1,871	15.8	7.8
Plainfield, N.J.	86,140	164	190.4	1,375	16.0	11.9
Plymouth, Pa.	74,710	22	29.4	1,143	15.3	1.9
Plymouth (town), Mass.	52,538	61	116.1	745	14.2	8.2
Pontiac, Mich.	53,025	44	83.0	926	17.5	4.7
Port Huron, Mich.	99,051	55	55.5	1,262	12.7	4.4
Port Jervis, N.Y.	47,855	83	173.4	829	17.3	10.0
Portsmouth, N.H.	54,400	93	171.0	976	17.9	9.6
Portsmouth, Ohio	96,460	203	210.4	1,478	15.3	13.7
Pottstown, Pa.	69,095	108	156.3	1,049	15.2	10.3
Pottsville, Pa.	80,935	86	106.3	1,448	17.9	5.9
Poughkeepsie, N.Y.	123,493	199	161.1	2,256	18.3	8.8
Pueblo, Col.	146,685	496	338.1	3,853	26.3	12.9
Quincy, Mass.	132,023	187	141.6	1,808	13.7	10.3
Raleigh, N.C.	69,670	239	343.0	1,695	24.3	14.1
Revere (town), Mass.	58,765	63	107.2	736	12.5	8.6
Richmond, Ind.	93,960	165	175.6	1,556	16.6	10.6
Rochester, N.H.	43,935	98	223.1	691	15.7	14.2
Rockland, Me.	40,750	87	213.5	771	18.9	11.3
Rome, N.Y.	82,671	151	182.7	1,436	17.4	10.5

TABLE I.—*Continued.*

Cities.	Population (1901–05).	Deaths from Consumption.		Deaths from all Causes.		Per Cent. of Total Deaths due to Consumption.
		Number.	Rates. per 100,000 Population.	Number.	Rates. per 1,000 Population.	
Rutland, Vt.	58,650	90	153.5	1,080	18.4	8.3
Sacramento, Cal.	150,760	431	285.9	3,075	20.4	14.0
San Diego, Cal.	92,100	393	426.7	2,066	22.4	19.0
San José, Cal.	112,660	295	261.8	1,809	16.1	16.3
Saratoga Springs, N.Y.	63,815	135	211.5	1,374	21.5	9.8
Sault Ste. Marie, Mich.	56,080	55	97.9	1,006	17.9	5.5
South Bethlehem, Pa.	70,615	96	135.9	1,112	15.7	8.7
Southbridge (town), Mass.	53,050	73	137.6	882	16.6	8.3
Stamford (town), Conn.	98,905	155	156.7	1,968	19.9	7.9
Steelton, Pa.	65,011	107	164.6	1,096	16.9	9.7
Stonington (town), Conn.	44,740	67	149.8	752	16.8	8.9
Tiffin, Ohio	55,105	87	157.9	742	13.5	11.7
Torrington (town), Conn.	71,880	91	126.6	836	11.6	10.9
Traverse City, Mich.	53,896	88	163.3	985	18.3	8.9
Union, N.J.	81,386	126	154.8	1,358	16.7	9.3
Vernon (town), Conn.	41,920	45	107.3	591	14.1	7.6
Vincennes, Ind.	53,954	112	207.6	938	17.4	11.9
Wabash, Ind.	46,405	72	155.2	543	11.7	13.2
Wakefield (town), Mass.	49,381	90	182.3	649	13.1	13.9
Wallingford (town), Conn.	48,635	55	113.1	623	12.8	8.8
Waltham, Mass.	125,806	182	144.7	1,722	13.7	10.5
Ware (town), Mass.	42,306	78	184.4	647	15.3	12.1
Washington, Ind.	46,490	100	215.1	648	13.9	15.5
Watertown, N.Y.	119,220	114	95.6	1,772	14.9	6.4
Watertown (town), Mass.	53,183	60	112.8	651	12.2	9.2
Watervliet, N.Y.	72,085	128	177.6	1,207	16.7	10.6
Webster (town), Mass.	47,660	63	132.2	739	15.5	8.5
Westfield (town), Mass.	65,451	94	143.6	1,073	16.4	8.8
Weymouth (town), Mass.	57,401	87	151.6	850	14.8	10.2
Williamsport, Pa.	146,230	170	116.3	2,055	14.1	8.2
Wilmington, N.C.	106,260	249	234.3	2,873	27.0	8.7
Windham (town), Conn.	50,850	109	214.4	917	18.0	11.9
Winona, Minn.	100,430	107	106.5	1,241	12.4	8.6
Woburn, Mass.	71,711	126	175.7	1,086	15.1	11.6
Total (209 cities)	16,453,012	25,927	157.6	264,071	16.1	9.8

TABLE II.

PERCENTAGE OF CHILDREN AND NEGROES IN 209 SMALL CITIES OF THE UNITED STATES AND ALTITUDE OF THE CITIES.

(*Census of* 1900.)

Cities.	Total Population.	Children (Ages 0–4).		Negroes.		Altitude in Feet.
		Number.	Per Cent.	Number.	Per Cent.	
Adams (town), Mass.	11,134	1,303	11.7	18	0.16	799
Alameda, Cal.	16,464	1,336	8.1	144	1.00	12
Alexandria, Va.	14,528	1,439	9.9	4,533	31.20	50
Amesbury (town), Mass.	9,473	848	9.0	23	0.24	26
Amsterdam, N.Y.	20,929	2,044	9.8	94	0.45	275
Anderson, Ind.	20,178	(?)	(?)	680	3.37	875
Ann Arbor, Mich.	14,509	893	6.2	359	2.47	791
Annapolis, Md.	8,525	782	9.2	3,002	35.21	16
Ansonia, Conn.	12,681	1,624	12.8	501	3.95	31
Appleton, Wis.	15,085	1,846	12.2	18	0.12	712
Arlington (town), Mass.	8,603	961	11.2	75	0.87	48
Ashtabula, Ohio	12,949	1,685	13.0	75	0.58	654
Attleboro (town), Mass.	11,335	1,023	9.0	111	0.98	133
Augusta, Me.	11,683	1,034	8.8	51	0.44	47
Aurora, Ill.	24,147	2,395	9.9	211	0.87	661
Bangor, Me.	21,850	1,831	8.4	176	0.81	21
Barre, Vt.	8,448	1,095	13.0	3	0.00	515
Bath, Me.	10,477	967	9.2	40	0.38	7
Battle Creek, Mich.	18,563	1,426	7.7	527	2.84	820
Bellaire, Ohio	9,912	1,081	10.9	428	4.32	670
Belleville, Ill.	17,484	1,835	10.5	230	1.32	502
Beloit, Wis.	10,436	978	9.4	66	0.63	745
Bennington (town), Vt.	8,033	710	8.8	38	0.67	725
Berlin, N.H.	8,886	1,465	16.5	—	—	1,012
Beverly, Mass.	13,884	1,215	8.8	50	0.36	28
Biddeford, Me.	16,145	1,762	10.9	1	0.00	75
Bridgeton, N.J.	13,913	1,249	9.0	701	5.04	42
Bristol, Conn.	9,643	997	10.3	19	0.30	332
Brookline (town), Mass.	19,935	1,650	8.3	161	0.81	10
Burlington, Ia.	23,201	2,031	8.8	403	1.74	502
Burlington, Vt.	18,640	1,781	9.6	115	0.62	190
Carbondale, Pa.	13,536	1,525	11.3	4	0.00	1,078
Carlisle, Pa.	9,626	786	8.2	1,148	11.93	489
Central Falls City, R.I.	18,167	2,214	12.2	62	0.34	88
Chicopee, Mass.	19,167	2,481	12.9	10	0.00	84
Chillicothe, Ohio	12,976	1,123	8.7	986	7.60	632
Clinton (town), Mass.	13,667	1,462	10.7	24	0.18	282
Cohoes, N.Y.	23,910	2,228	9.3	15	0.00	155
Columbia, Pa.	12,316	1,395	11.3	421	3.42	255
Columbus, Ind.	8,130	753	9 3	224	2.76	631
Concord, N.H.	19,632	1,677	8.5	58	0.30	264
Corning, N.Y.	11,061	1,078	9.7	119	1.07	937
Cortland, N.Y.	9,014	695	7.7	51	0.57	1,125

TABLE II.—*Continued.*

Cities.	Total Population.	Children (Ages 0–4).		Negroes.		Altitude in Feet.
		Number.	Per Cent.	Number.	Per Cent.	
Danbury (town), Conn.	19,477	1,717	8.8	241	1.46	371
Danvers (town), Mass.	8,542	706	8.3	10	0.11	42
Decatur, Ill.	20,754	2,004	9.7	620	2.99	679
Dover, N.H.	13,207	1,150	8.7	15	0.11	77
Dubois, Pa.	9,375	1,317	14.0	24	0.26	1,399
Dunkirk, N.Y.	11,616	1,401	12.0	10	0.09	613
Eau Claire, Wis.	17,517	2,013	11.5	11	0.06	776
Elkhart, Ind.	15,184	(?)	(?)	35	0.24	754
Elwood, Ind.	12,950	(?)	(?)	5	0.00	860
Escanaba, Mich.	9,549	1,262	13.2	25	0.26	597
Everett, Mass.	24,336	2,850	11.7	634	2.61	12
Findlay, Ohio	17,613	1,634	9.3	294	1.67	780
Flint, Mich.	13,103	857	6.5	257	1.96	716
Framingham (town), Mass.	11,302	954	8.4	38	0.33	180
Frederick, Md.	9,296	927	10.0	1,535	16.51	271
Fresno, Cal.	12,470	1,052	8.4	291	2.33	287
Gardner (town), Mass.	10,813	1,185	11.0	53	0.49	1,030
Geneva, N.Y.	10,433	877	8.4	193	1.85	471
Glens Falls, N.Y.	12,613	1,095	8.7	33	0.26	279
Gloucester, Mass.	26,121	2,622	10.0	39	0.15	52
Gloversville, N.Y.	18,349	1,268	6.9	216	1.18	821
Green Bay, Wis.	18,684	2,418	12.9	33	0.18	604
Greenwich (town), Conn.	12,172	1,337	11.0	356	2.92	28
Hamilton, Ohio	23,914	2,458	10.3	347	1.45	597
Hammond, Ind.	12,376	(?)	(?)	17	0.14	593
Harrison, N.J.	10,596	1,293	12.2	49	0.46	38
Hazleton, Pa.	14,230	1,794	12.6	14	0.10	1,624
Hudson, N.Y.	9,528	664	7.0	424	4.45	67
Huntington, Ind.	9,491	(?)	(?)	8	0.08	742
Hyde Park (town), Mass.	13,244	1,313	9.9	116	0.87	59
Iron Mountain, Mich.	9,242	1,510	16.3	5	0.00	1,160
Ironton, Ohio	11,868	1,169	9.8	924	7.79	529
Ironwood, Mich.	9,705	1,733	17.9	1	0.00	1,500
Ishpeming, Mich.	13,255	1,918	14.5	—	—	1,434
Ithaca, N.Y.	13,136	836	6.4	364	2.77	611
Jackson, Mich.	25,180	1,951	7.7	473	1.88	942
Jacksonville, Ill.	15,078	1,026	6.8	997	6.61	603
Jamestown, N.Y.	22,892	2,134	9.3	77	0.34	1,323
Jeffersonville, Ind.	10,774	1,063	9.9	1,818	1.69	451
Johnstown, N.Y.	10,130	796	7.9	108	1.07	650
Keene, N.H.	9,165	781	8.5	5	0.00	497
Key West, Fla.	17,114	2,141	12.5	5,562	32.50	22
Kingston, N.Y.	24,535	2,233	9.1	545	2.22	197
Kokomo, Ind.	10,609	(?)	(?)	359	3.38	806
Laconia, N.H.	8,042	643	8.0	21	0.26	507
Lafayette, Ind.	18,116	1,483	8.2	344	1.90	577
Lansing, Mich.	16,485	1,302	7.9	323	1.96	843

TABLE II.—*Continued.*

Cities.	Total Population.	Children (Ages 0–4).		Negroes.		Altitude in Feet.
		Number.	Per Cent.	Number.	Per Cent.	
Leadville, Col.	12,455	1,140	9.2	195	1.57	10,187
Leavenworth, Kan.	20,735	1,994	9.6	2,925	14.10	780
Leominster (town), Mass.	12,392	1,142	9.2	75	0.61	404
Lima, Ohio	21,723	2,378	10.9	731	3.37	876
Lockport, N.Y.	16,581	1,466	8.8	160	0.96	541
Logansport, Ind.	16,204	(?)	(?)	167	1.03	597
Lynchburg, Va.	18,891	1,964	10.4	8,254	43.69	607
Madison, Wis.	19,164	1,703	8.9	69	0.36	888
Mahanoy City, Pa.	13,504	1,952	14.5	4	0.00	1,236
Manchester (town), Conn.	10,601	1,153	10.9	43	0.41	177
Manitowoc, Wis.	11,786	1,472	12.5	3	0.59	595
Mankato, Minn.	10,599	1,100	10.4	7	0.00	775
Marietta, Ohio	13,348	1,213	9.1	361	2.70	618
Marinette, Wis.	16,195	2,310	14.3	1	0.00	597
Marion, Ind.	17,337	(?)	(?)	650	3.74	812
Marlboro, Mass.	13,609	1,243	9.1	31	0.23	375
Marquette, Mich.	10,058	1,197	11.9	62	0.42	642
Massillon, Ohio	11,944	1,236	10.3	83	0.69	975
Meadville, Pa.	10,291	774	7.5	173	1.68	1,078
Medford, Mass.	18,244	1,870	10.3	244	1.34	13
Melrose, Mass.	12,962	1,204	9.3	130	1.00	59
Menominee, Mich.	12,818	1,930	15.1	—	—	594
Michigan City, Ind.	14,850	1,634	11.0	197	1.33	608
Middletown, N.Y.	14,522	1,107	7.6	380	2.62	631
Middletown, Ohio	9,215	902	9.8	314	3.41	664
Middletown (town), Conn.	17,486	1,469	8.4	127	1.33	55
Milford (town), Mass.	11,376	1,035	9.1	24	0.21	266
Millville, N.J.	10,583	1,062	10.0	139	1.31	35
Montclair, N.J.	13,962	1,341	9.6	1,344	9.63	241
Morristown, N.J.	11,267	1,075	9.5	815	7.23	372
Mt. Carmel, Pa.	13,179	2,153	16.3	10	0.08	1,056
Mt. Vernon, N.Y.	21,228	2,538	12.0	516	2.43	114
Muncie, Ind.	20,942	2,004	9.6	739	3.53	945
Muscatine, Ia.	14,073	1,436	10.2	125	0.89	547
Muskegon, Mich.	20,818	2,078	10.0	23	0.11	599
Nashua, N.H.	23,898	2,550	10.7	62	0.26	138
Natick (town), Mass.	9,488	838	8.8	52	0.55	164
Naugatuck, Conn.	10,541	1,426	13.5	31	0.29	194
New Albany, Ind.	20,628	(?)	(?)	1,905	9.23	442
New Brunswick, N.J.	20,006	1,890	9.4	755	3.77	61
New London, Conn.	17,548	1,571	9.0	378	2.15	27
New Rochelle, N.Y.	14,720	1,826	12.4	777	5.28	72
Newark, Ohio	18,157	1,774	9.8	300	1.65	822
Newburg, N.Y.	24,943	2,230	8.9	558	2.24	69
Newburyport, Mass.	14,478	1,243	8.6	97	0.67	39
Newport, Ky.	28,301	2,806	9.9	424	1.50	507
Newport, R.I.	22,034	2,109	9.6	1,613	7.32	25

TABLE II.—*Continued.*

Cities.	Total Population.	Children (Ages 0–4).		Negroes.		Altitude in Feet.
		Number.	Per Cent.	Number.	Per Cent.	
Niagara Falls, N.Y.	19,457	1,945	10.0	344	1.77	578
Norristown, Pa.	22,265	1,749	7.9	728	3.27	83
North Adams, Mass.	24,200	2,896	12.0	90	0.37	706
Northampton, Mass.	18,643	1,623	8.7	108	0.58	124
Norwalk (town), Conn.	19,932	1,810	9.1	189	3.09	28
Norwich (town), Conn.	24,637	2,316	9.4	544	3.15	33
Ogdensburg, N.Y.	12,633	1,261	10.0	23	0.18	276
Olean, N.Y.	9,462	867	9.2	122	1.29	1,435
Orange, N.J.	24,141	2,754	11.4	1,903	7.88	184
Ottawa, Ill.	10,588	998	9.4	34	0.32	496
Owosso, Mich.	8,696	694	8.0	22	0.25	740
Paducah, Ky.	19,446	1,846	9.5	5,814	29.90	344
Peabody (town), Mass.	11,523	1,194	10.4	38	0.33	19
Peekskill, N.Y.	10,358	1,007	9.7	243	2.34	11
Perth Amboy, N.J.	17,699	2,620	14.8	89	0.50	55
Peru, Ind.	8,463	765	9.0	67	0.79	643
Petersburg, Va.	21,810	2,195	10.1	10,751	49.29	58
Phillipsburg, N.J.	10,052	914	9.1	36	0.36	207
Pittsfield, Mass.	21,766	2,023	9.3	277	1.27	1,026
Plainfield, N.J.	15,369	1,461	9.5	1,450	9.43	102
Plymouth, Pa.	13,649	1,990	14.5	25	0.18	535
Plymouth (town), Mass.	9,592	968	10.1	146	1.52	38
Pontiac, Mich.	9,769	784	8.0	151	1.55	933
Port Huron, Mich.	19,158	1,741	9.1	69	0.36	596
Port Jervis, N.Y.	9,385	842	9.0	119	1.27	451
Portsmouth, N.H.	10,637	891	8.4	101	0.94	14
Portsmouth, Ohio.	17,870	1,773	9.9	947	5.30	507
Pottstown, Pa.	13,696	1,428	10.4	292	2.13	144
Pottsville, Pa.	15,710	1,526	9.7	168	1.07	618
Poughkeepsie, N.Y.	24,209	1,926	8.0	623	2.59	138
Pueblo, Col.	28,157	2,851	10.1	1,213	4.31	4,669
Quincy, Mass.	23,899	2,780	11.6	27	0.11	40
Raleigh, N.C.	13,643	1,458	10.7	5,721	41.93	352
Revere (town), Mass.	10,395	1,170	11.2	43	0.41	16
Richmond, Ind.	18,226	1,403	7.7	1,009	5.54	958
Rochester, N.H.	8,466	823	9.7	3	0.00	229
Rockland, Me.	8,150	564	6.9	31	0.38	(?)
Rome, N.Y.	15,343	1,369	8.9	89	0.58	436
Rutland, Vt.	11,499	1,007	8.7	54	0.47	562
Sacramento, Cal.	29,282	2,130	7.3	402	1.37	30
San Diego, Cal.	17,700	1,247	7.0	313	1.77	30
San José, Cal.	21,500	1,480	6.9	209	0.97	98
Saratoga Springs, N.Y.	12,409	987	7.9	619	4.99	294
Sault Ste. Marie, Mich.	10,538	1,170	11.1	22	0.21	608
South Bethlehem, Pa.	13,241	1,676	12.7	115	0.87	239
Southbridge (town), Mass.	10,025	1,160	11.6	29	0.29	490
Stamford (town), Conn.	18,839	1,872	9.9	256	1.60	34

TABLE II.—*Continued.*

Cities.	Total Population.	Children (Ages 0–4).		Negroes.		Altitude in Feet.
		Number.	Per Cent.	Number.	Per Cent.	
Steelton, Pa.	12,086	1,296	10.7	1,508	12.47	308
Stonington (town), Conn.	8,540	871	10.2	141	1.65	7
Tiffin, Ohio	10,989	913	8.3	44	0.40	753
Torrington (town), Conn.	12,453	1,614	13.0	67	0.80	593
Traverse City, Mich.	9,407	837	8.9	8	0.09	599
Union, N.J.	15,187	1,895	12.5	7	0.00	140
Vernon (town), Conn.	8,483	795	9.4	28	0.38	407
Vincennes, Ind.	10,249	949	9.3	432	4.21	429
Wabash, Ind.	8,618	(?)	(?)	134	1.55	727
Wakefield (town), Mass.	9,290	884	9.5	25	0.27	102
Wallingford (town), Conn.	9,001	1,033	11.5	21	0.31	75
Waltham, Mass.	23,481	2,023	8.6	51	0.22	79
Ware (town), Mass.	8,263	890	10.8	—	—	488
Washington, Ind.	8,551	(?)	(?)	255	2.98	483
Watertown, N.Y.	21,696	1,876	8.7	75	0.34	454
Watertown (town), Mass.	9,706	931	9.6	53	0.55	19
Watervliet, N.Y.	14,321	1,325	9.3	59	4.12	32
Webster (town), Mass.	8,804	1,141	13.0	32	0.36	440
Westfield (town), Mass.	12,310	1,225	10.0	81	0.66	149
Weymouth (town), Mass.	11,324	955	8.4	40	0.35	30
Williamsport, Pa.	28,757	2,600	9.0	1,142	3.97	525
Wilmington, N.C.	20,796	2,265	10.9	10,407	49.61	52
Windham (town), Conn.	10,137	952	9.4	74	0.83	247
Winona, Minn.	19,714	2,326	11.8	30	0.15	651
Woburn, Mass.	14,254	1,566	11.0	261	1.83	98
Totals	3,099,286	293,246	9.5	104,839	3.57	

TABLE III.

MORTALITY FROM CONSUMPTION IN 209 SMALL CITIES OF THE UNITED STATES, 1901–05.

(*The Cities are arranged in the order of the Death-rates per* 100,000 *of Population.*)

Cities.	Rates.	Cities.	Rates.
San Diego, Cal.	426.7	Paducah, Ky.	327.4
Petersburg, Va.	348.5	Key West, Fla.	300.9
Raleigh, N.C.	343.0	Ogdensburg, N.Y.	291.3
Pueblo, Col.	338.1	Orange, N.J.	289.9
Annapolis, Md.	331.8	Sacramento, Cal.	285.9

TABLE III.—*Continued.*

Cities.	Rates.	Cities.	Rates.
Danvers (town), Mass.	284.6	Peekskill, N.Y.	167.5
Norristown, Pa.	275.6	Adams (town), Mass.	167.4
Frederick, Md.	270.1	Naugatuck, Conn.	167.3
San José, Cal.	261.8	Escanaba, Mich.	166.2
Alexandria, Va.	259.2	Huntington, Ind.	165.9
Jeffersonville, Ind.	255.4	New Brunswick, N.J.	165.4
Middletown (town), Conn.	254.3	Dover, N.H.	165.0
Lynchburg, Va.	252.0	Steelton, Pa.	164.6
Fresno, Cal.	251.4	Traverse City, Mich.	163.3
Ironton, Ohio	246.1	Everett, Mass.	162.5
Jacksonville, Ill.	237.9	Nashua, N.H.	162.2
Columbus, Ind.	236.2	Muncie, Ind.	162.0
New Albany, Ind.	234.6	Augusta, Me.	161.3
Wilmington, N.C.	234.3	Poughkeepsie, N.Y.	161.1
Lafayette, Ind.	223.8	Norwich (town), Conn.	160.9
Rochester, N.H.	223.1	Bridgeton, N.J.	160.1
Newburg, N.Y.	221.9	Marion, Ind.	158.5
Cohoes, N.Y.	220.8	Tiffin, Ohio	157.9
Washington, Ind.	215.1	Lima, Ohio	157.0
Windham (town), Conn.	214.4	Manitowoc, Wis.	157.0
Rockland, Me.	213.5	Natick (town), Mass.	156.9
Saratoga Springs, N.Y.	211.5	Stamford, Conn.	156.7
Portsmouth, Ohio	210.4	Pottstown, Pa.	156.3
Vincennes, Ind.	207.6	Bellaire, Ohio	155.4
Barre, Vt.	205.4	Wabash, Ind.	155.2
Kokomo, Ind.	201.5	Union, N.J.	154.8
New London, Conn.	199.1	Chicopee, Mass.	154.7
Middletown, N.Y.	193.2	Bath, Me.	154.5
Kingston, N.Y.	193.1	Central Falls, R.I.	154.2
Morristown, N.J.	191.6	Ansonia, Conn.	153.9
Plainfield, N.J.	190.4	Rutland, Vt.	153.5
Logansport, Ind.	188.7	Leavenworth, Kan.	153.3
Danbury (town), Conn.	185.9	Norwalk (town), Conn.	152.5
Biddeford, Me.	184.9	Findlay, Ohio	152.2
Ware (town), Mass.	184.4	Newburyport, Mass.	152.1
Carlisle, Pa.	183.7	Weymouth (town), Mass.	151.6
Hudson, N.Y.	183.5	Hyde Park (town), Mass.	150.0
Rome, N.Y.	182.7	Stonington (town), Conn.	149.8
Chillicothe, Ohio	182.5	Hamilton, Ohio	148.9
Wakefield (town), Mass.	182.3	Manchester (town), Conn.	148.5
Amesbury (town), Mass.	178.1	Amsterdam, N.Y.	147.3
Harrison, N.J.	177.7	Attleboro (town), Mass.	146.4
Watervliet, N.Y.	177.6	Marlboro, Mass.	145.5
Woburn, Mass.	175.7	Waltham, Mass.	144.7
Richmond, Ind.	175.6	North Adams, Mass.	144.5
Newport, Ky.	174.7	Concord, N.H.	144.0
Anderson, Ind.	173.8	Westfield (town), Mass.	143.6
Bangor, Me.	173.8	Gloucester, Mass.	143.5
Port Jervis, N.Y.	173.4	Elkhart, Ind.	143.1
Portsmouth, N.H.	171.0	Beloit, Wis.	143.0
Laconia, N.H.	169.1	Marquette, Mich.	142.7
Middletown, Ohio	168.5	Newport, R.I.	141.7

TABLE III.—*Continued.*

Cities.	Rates.	Cities.	Rates.
Quincy, Mass.	141.6	Madison, Wis.	108.9
Newark, Ohio	140.8	Gloversville, N.Y.	108.2
Glens Falls, N.Y.	140.2	Jamestown, N.Y.	108.2
Belleville, Ill.	139.1	Elwood, Ind.	108.1
Mankato, Minn.	138.4	Clinton (town), Mass.	108.0
Decatur, Ill.	138.1	Hammond, Ind.	107.9
Southbridge (town), Mass.	137.6	Iron Mountain, Mich.	107.4
Beverly, Mass.	137.5	Vernon (town), Conn.	107.3
Milford (town), Mass.	137.1	Revere (town), Mass.	107.2
Peabody (town), Mass.	136.3	Winona, Minn.	106.5
South Bethlehem, Pa.	135.9	Pottsville, Pa.	106.3
Lockport, N.Y.	135.8	Johnstown, N.Y.	104.9
Burlington, Ia.	135.7	Phillipsburg, N.J.	104.7
Millville, N.J.	135.5	Marinette, Wis.	104.5
Bennington (town), Vt.	133.7	Muskegon, Mich.	101.5
Webster (town), Mass.	132.2	Framingham (town), Mass.	101.3
Burlington, Vt.	132.0	Jackson, Mich.	101.3
Eau Claire, Wis.	131.5	Niagara Falls, N.Y.	99.8
Ithaca, N.Y.	130.4	Columbia, Pa.	98.0
Arlington (town), Mass.	129.8	Sault Ste. Marie, Mich.	97.9
Ishpeming, Mich.	129.7	Ann Arbor, Mich.	97.4
Northampton, Mass.	128.7	Watertown, N.Y.	95.6
Leominster (town), Mass.	128.6	New Rochelle, N.Y.	94.9
Gardner (town), Mass.	126.6	Flint, Mich.	92.0
Torrington (town), Conn.	126.6	Menominee, Mich.	90.2
Alameda, Cal.	126.3	Massillon, Ohio	89.6
Keene, N.H.	124.0	Hazleton, Pa.	89.0
Pittsfield, Mass.	124.0	Carbondale, Pa.	85.6
Montclair, N.J.	123.3	Berlin, N.H.	84.3
Michigan City, Ind.	123.2	Geneva, N.Y.	83.7
Ottawa, Ill.	123.1	Pontiac, Mich.	83.0
Melrose, Mass.	122.1	Owosso, Mich.	81.9
Green Bay, Wis.	121.8	Muscatine, Ia.	81.7
Corning, N.Y.	120.1	Dunkirk, N.Y.	81.4
Peru, Ind.	118.4	Brookline (town), Mass.	80.8
Battle Creek, Mich.	117.4	Mt. Carmel, Pa.	80.5
Williamsport, Pa.	116.3	Meadville, Pa.	78.7
Medford, Mass.	116.2	Ironwood, Mich.	76.5
Plymouth (town), Mass.	116.1	Perth Amboy, N.J.	76.1
Appleton, Wis.	115.8	Cortland, N.Y.	73.6
Greenwich (town), Conn.	115.8	Lansing, Mich.	56.9
Mt. Vernon, N.Y.	115.1	Mahanoy City, Pa.	56.3
Marietta, Ohio	114.3	Port Huron, Mich.	55.5
Wallingford, Conn.	113.1	Olean, N.Y.	54.9
Ashtabula, Ohio	112.8	Dubois, Pa.	54.1
Watertown, Mass.	112.8	Plymouth, Pa.	29.4
Bristol, Conn.	112.4	Leadville, Col.	21.4
Aurora, Ill.	111.4		

DEVELOPMENT OF VITAL STATISTICS.

By Henry D. Holton, A.M., M.D., Secretary, State Board of Health, Vermont.

It is not necessary more than to allude to the fact that Vital Statistics are the basis upon which State and municipal sanitation rest. This was early recognized by the Colonies, as has been pointed out by Chapin. Virginia, in 1631, required that ministers and church wardens should report marriages, births, and deaths. In 1639 the Colony of Massachusetts adopted registration regulations, and seven years later the Plymouth Colony followed its example. Various municipalities required reports of vital statistics. In 1856 the legislature of Vermont placed on the statute book a law requiring the reporting of all marriages, births, and deaths. The school district clerks were required to visit every home in their respective districts in January, and, make careful inquiry as to the number of births and deaths that had occurred in the home during the year previous, and report the same to the town clerk. Ministers and magistrates were also required to report all marriages. The town clerk was to transmit all of these reports to the Secretary of State, who was required to receive the returns, and, with the assistance that might be voluntarily rendered to him by any authorized committee of the Vermont Medical Society, to prepare such tabular results as might render them of practical utility and report thereon to the legislature. This method of registration continued for forty-one years. Imperfect as it was in its methods, valuable data were preserved. In 1898 the registration law at present in operation was passed, although there have been slight amendments made to perfect its operation. No body of a human being can be buried, removed, or cremated, unless the local health officer first issues a permit for that purpose. The physician last in attendance upon a deceased person must immediately fill out a certificate of death, and within thirty-six hours deliver the certificate to the family or undertaker. The blanks for all certificates, under the Act, are furnished by the State Board of Health. The certificate of birth must be made by the physician or head of the family and returned within ten days to the town clerk, who receives and retains in his office, as the permanent record of the office, the certificates of marriages, births, and deaths. He is supplied by the State Board of Health with abstracts sheets on which he must return

semi-annually a copy of each certificate to the Secretary of the State Board of Health. (We hope soon to secure an amendment requiring the returns to the State Board to be made monthly.) The accuracy of the returns by this method is evidenced first, in that the ill-defined causes of death are less by two-thirds than under the former Act; second, in that all deaths are returned, as no body can be buried without a permit based upon the certificate of death.

Regarding the returns of births the case is quite different. The careless physician neglects to return births until the town clerk notifies him of his delinquency, although he receives twenty-five cents for each birth and death certificate returned. I am persuaded that in many instances the doctor who sits down weeks, and perhaps months, after a birth to make up his returns, fails to remember some of them: hence, they do not get reported. There are now only sixteen States that have a similar act requiring all marriages, births, and deaths to be reported. One of the first missions of this Section should be to urge upon the remaining States that they adopt similar laws, to the end that we may have uniformity throughout the nation. Agitation to show the importance of this registration should be continued until every State secures the required legislation.

With the standard required by the Census Bureau we may reasonably expect that this Section will be a very material power in bringing the vital statistics of the whole country much nearer a state of reliability and desired perfection. To this end the International Classification of Causes of Death should be revised during or before 1910.

The sanitarians of the country are to be congratulated upon the success that has attended their labors to improve the hygienic conditions under which we live to-day. The prevention of communicable diseases and the better sanitary conditions surrounding us have made it possible for a much larger number of persons to reach advanced age, although in the middle period of life the mortality from some organic diseases has increased. The "strenuous" life has much to do with the increasing death-rate from both organic heart disease and apoplexy. In short, we need to return to the "simple life," cultivating a broad, unselfish philanthropy in efforts to relieve the unfortunate and distressed, helping them to reach higher planes of mental and moral life, making it possible for them to live in sanitary homes and be surrounded by pleasant, healthy, uplifting influences other than those that tend to physical and moral degradation.

In the small State of Vermont, where there is a greater equality of environment and methods of living than in a large municipality or in States with a greater diversity of general conditions, the vital statistics show more accurately the result of sanitary improvements.

It is interesting to learn from our registration of fifty years just what changes have taken place in this rural commonwealth in the causes of death. We find that in comparing the first registration report, made in 1857, with the last, for 1906, that, taking the deaths from the communicable diseases of typhoid fever, measles, scarlatina, whooping-cough, and tuberculosis in this State, there were in 1857 1,179 deaths or one to every 266 of the inhabitants. In 1906 there were 613, or only one to every 571 of the inhabitants. In 1857 tuberculosis alone caused the death of 848, or one in 370. In 1906 the deaths were 453, only one in 772. Typhoid fever in 1857 caused 169 deaths, one in 1,858. In 1906 there were only 70 deaths, being one in 5,000.

There has been an increase in certain diseases, as there has been throughout the country. In 1857 cancer caused 73 deaths, only one in 4,301 persons. In 1906 it added to the death-roll 287, or one in 1,219. Pneumonia in 1857 led with 163 deaths, or one in 1,926. In 1906 there were 575 deaths, or one in 608. In 1857 organic heart disease destroyed only 125, or one in 2,512 persons. In 1906 there were reported from this cause 577 deaths, or one in 606. Apoplexy in 1857 caused death in 71 cases, or only one in 4,422. In 1906 the number of deaths from this cause was 430, or one in 813.

We also find that in the first period only one person in 754 lived to be eighty years old or over, while in the last period one in every 425 was eighty or over.

The average age at death was, in the first period, 38; in the latter, 48. Fractions have been discarded in the above figures.

From these statistics we must be impressed that our duty in the future is a more rigid enforcement of means calculated to secure the absolute suppression of communicable diseases, with a continued effort in the direction of determining the cause of those diseases which continue, with increasing certainty, to decimate our people during middle life. To this end we would suggest that a committee be appointed to co-operate with a similar committee from the Laboratory Section, with a view to making a special effort to determine the causes of the diseases that our vital statistics indicate are so rapidly on the increase.

THE METHODS EMPLOYED IN MAINE IN CHECKING THE RETURNS OF BIRTHS, MARRIAGES, AND DEATHS.

By Dr. A. G. Young, Secretary, State Board of Health, Augusta, Me.

I preface what I have to say with a statement of some of the provisions of the Maine registration law.

The Secretary of the State Board of Health is *ex-officio* State Registrar of Vital Statistics, and the law provides that he shall enforce its provisions as far as comes within his power, and further provides that, when any penalty or forfeiture has been incurred, he shall put the case into the hands of the proper prosecuting attorney. Births must be reported to the town or city clerk by the physician or midwife within six days of the events. Intentions of marriage must be recorded. No clergyman or justice may solemnize a marriage until he has received a marriage certificate from the hands of the parties to the proposed marriage, and a report of the marriage must be made to the town clerk within six days. When deaths occur, the attending physician must furnish a certificate of the cause of death, but the onus of completing the certificate and obtaining a burial permit is on the undertaker or other person who moves the body or superintends the burial. The obligation is also upon householders to report births and deaths which occur in their houses or families. Until this year annual reports were made by the local clerks to the State Registrar, but beginning with this year a provision for monthly returns of births, marriages, and deaths went into effect.

In Maine the methods in use for checking or controlling and making more nearly complete the returns of births, marriages, and deaths, are the following:—

Births.—The town clerk, when he learns of any birth which has not been reported to him, must collect and record the required facts so far as he is able to do so. For this he receives a special fee. The assessors, when taking the annual inventory in the month of April each year, collect and return to the town clerk the names of children born in the preceding year. The law provides that, when the town clerk makes his returns of births, marriages, and deaths to the State Registrar, he shall report to him the names, residences, and official stations of all persons who have neglected to make returns to him.

We have a system of newspaper clippings applying to marriages and deaths as well as to births. The office of the State Registrar subscribes to several newspapers which are published in different parts of the State, and which give quite full lists of births, marriages, and deaths. All birth, marriage, and death notices found are cut out. These clippings are pasted

upon pieces of manila paper 2 x 4¼ inches in size, sorted in three packages, and stamped with a rubber stamp "birth," "marriage," and "death," respectively. The items are arranged alphabetically under the name of the father of the child for births, of the bridegroom for marriages, and of the person deceased for deaths. A search for duplicates results in throwing out thousands. Those remaining are compared with the card returns of births, marriages, and deaths. This results in eliminating all but about a total of five hundred a year. These five hundred or thereabout represent the births, marriages, and deaths recorded in the newspapers, but which have not been returned to the State office. These clippings are sent to the respective town clerks, accompanied by a circular letter asking them to learn whether the events described actually occurred, and, if they did, to make and return the records together with a statement of who was responsible for the failure to make the reports to him.

In the last three years, clippings from four or five newspapers, all weekly but one, have brought in as a yearly average about 140 records of births, 20 records of marriages, and 75 records of deaths which had not been received before, or a total of about 235 additional records each year.

Marriages.—In checking the returns of marriages, we have nothing to depend upon but the co-operation of the town clerks, to which reference has already been made, and the system of newspaper clippings just outlined.

Deaths.—Besides getting on the track of persons who have failed to comply with the requirements of the law, through newspaper clippings and the co-operation of town clerks we are now preparing to make use of the duplicate part of the transit permits returned to the office by the transportation companies, and also of the applications to the State Board of Health for disinterment permits.

This system of newspaper clippings entails much work, and the number of additional returns obtained is comparatively small. It is perhaps questionable whether the results pay for the trouble and expense. I have concluded that they do pay. The wide-spread moral effect of this system on those whom the law requires to perform certain duties is, I think, its greatest value, for they are made to perceive that information of lapses of duty is often received by the executive officer of the registration department. All these cases of default alphabetically arranged are recorded upon blanks and form what we call the "sombre list": it extends back over years. This list and the correspondence which it initiates show most of the cases of default to be unintentional, the result of occasional forgetfulness, accident, or misunderstandings. But it also reveals habits of gross and wilful negligence on the part of some physicians, undertakers, and persons, and constitutes a record which at any time may be made the basis of action on the part of the County Attorney.

THE PRACTICAL APPLICATION OF VITAL STATISTICS.

By William C. Woodward, M.D., Health Officer, District of Columbia.

The Committee of the American Health Association on Demography and Vital Statistics in their Sanitary Relations, in a report made in 1902, spoke as follows:—

"Deaths are registered primarily for legal purposes; that is, for the protection of certain rights and privileges of individuals and of families. This is the first and most important use of records of deaths, and the sort of utility which appeals most strongly to the general public wherever such records have been long kept. A subsidiary, though highly valuable, use of registration is for the compilation of sanitary statistics, by which the local, State, and Federal health services may direct their measures, improve their methods, and measure their results."

I am now somewhat inclined to resent the action of our committee—of which, however, I was an assenting member when this report was made—in asserting that the use of registration as a source of vital statistics is subsidiary to its use for legal purposes. Surely, if the health of the people should be the chief concern of the stateman, as has been wisely said, and if vital statistics serve to increase the efficiency of measures tending to preserve and to promote such health, the importance of registration is greater from a statistical standpoint than from the standpoint of the mere legal interests of an occasional individual or the occasional legal interests of the community as a whole. It may well be conceived that our committee had in mind, when it wrote its report, the actual extent and manner in which vital statistics are now used as indexes to the state of public health and as guides to sanitary effort rather than the extent to which they are susceptible of such use and the extent to which they should be so used. As yet, it seems to me, vital statistics serve but meagrely the ends of sanitation, and even by many professed sanitarians the possibilities for good which they contain are but poorly comprehended. Neither, I might add on the other hand, are the difficulties in the way of practical realization of such possibilities always comprehended.

The birth-rate is of interest chiefly from a sociological standpoint. Death-rates, general and special, and morbidity rates must be relied upon to show where and how sanitary work is needed, and to show the results of sanitary work already under way, and with death and

morbidity rates, therefore, we are chiefly concerned. Nowhere do the sanitary possibilities in vital statistics, and the difficulties in the way of their realization, become more apparent than in the study of the general death-rate, the popularly accepted index to the healthfulness of the community. For the death-rate of a community depends upon but four primary factors: first, an arbitrarily fixed unit of space; second, an arbitrarily fixed unit of time; third, the number of people; and, fourth, the number of deaths. And to the uninitiated it indicates well the sanitary condition. The secondary factors are, however, unfortunately almost innumerable. The number of deaths depends not merely upon the sanitary condition of the locality, or, speaking more broadly, upon its salubrity, but depends also upon the resistance of the individuals of whom the community is composed. When we go further and undertake to analyze the factors that go to make up salubrity, we find that they include the most varied conditions, as, for instance, the character and extent of changes of temperature, of prevailing winds, and of humidity; the character of soil; drainage, both artificial and natural; the character and location of dwellings; kinds of occupations; quality and availability of food supply and of water supply; the removal and disposal of wastes; and probably numerous other factors, all going to make up the entity that we call environment. And the variations in the character of the population which go to the determination of its resisting qualities are equally numerous,—age composition, racial factors, distribution by sex, intelligence, financial status, heredity, and so on. The slightest consideration must be sufficient, therefore, to show that, before the significance of a death-rate can be discovered, all of the factors and sub-factors that have been referred to, and probably others that have escaped mention, must be carefully investigated and evaluated. Only after this has been done for the same community from year to year, and after it has been done for various communities during corresponding periods, may it be possible to account, in part at least, for variations in the death-rate and to utilize the information thus obtained as a proper basis for action.

The greatest difficulty in determining the true value and the significance of the death-rate, along the lines laid down above, lies in the infrequency and incompleteness of census returns in so far as they relate to population. Returns of deaths may be sufficiently full and accurate to provide all data essential for work, but before different death-rates can be properly calculated, and their significance determined, it is necessary to have census returns for the same period compiled with equal fulness and accuracy and embodying corresponding data. It is not enough for the purposes of the health officer to know that in the territory under his jurisdiction more deaths occur during one period than during another,

but he must also know the causes of such deaths, and whether the fatalities were evenly distributed throughout the community or occurred in particular places or among particular classes of the population; and if the increase occurred with respect to certain diseases alone, or over limited areas, or in limited classes, he must be able to determine whether the increase was due to an increase in the population susceptible to that particular disease, or in the population living in that particular locality, or the population belonging to that particular class. If it was not due to an increase in the susceptible population, then by comparing those places and those classes in which it occurred with other places and classes showing similar mortality, and with places and classes in which it did not occur, he may ultimately learn something of the conditions leading to such increased mortality and discover means by which it may be prevented.

To carry this system to its logical conclusion, sanitary officers should have authority to require from time to time as investigations are under way, the reporting not merely of cases of death, as is now done, but also cases of disease, whether contagious or non-contagious. Investigations based upon reports of deaths alone cover relatively too small a number of cases to give the best results, and, moreover, fatal cases come to the knowledge of the sanitary authority in many instances too late to permit proper inquiry to be made as to the causes of the disease. It is probably only through some such systematic investigation of cases of non-contagious diseases, such as chronic nephritis, for instance, during the life of the patient, that the cause and method of prevention will be found.

Investigations such as have been suggested cannot be made through the mere compilation of vital statistics, but will depend largely on the analysis of the data which they contain. And for the purpose of furthering such analysis it will probably be found essential that trained investigators examine returns as they come in and supplement at once the information which they contain by information collected by personal investigation, if such added information is necessary to the proper classification and study of the case. Every record made should be carefully scrutinized at the time of its receipt to determine its sufficiency for purposes of the ultimate analysis to which it will be subjected, and any deficiencies should be supplied at once. To undertake to determine the condition of a community with respect to its health by mere office examination of written reports, without direct personal contact with the case reported and even without direct personal contact with those by whom such reports are made, is a more impracticable method of solving the grave sanitary problem that presents itself to the health officer than it would be for a chemist or a bacteriologist to undertake to determine the nature of chemical reactions or to determine the life histories of bacteria by simply

scrutinizing reports filed under similar circumstances. Work in the office must be supplemented by work in the laboratory and in the field, and in this case the community itself is the laboratory and the field in which the work must be done.

In order, then, that the greatest value may be obtained from the vital statistics that are being more and more extensively compiled every day, more attention must be paid to the scientific analysis of such statistics, not as mere figures but as scientific facts, so that they may actually afford a proper basis for rational sanitary measures rather than serve merely to flatter the community into a condition of self-complacency when the rates go down and to frighten it into a state of panic when they go upward.

SOME COMPARATIVE VITAL STATISTICS OF ONTARIO AND MICHIGAN.

By Mr. Archibald Blue, Chief Officer of the Census and Statistics Office of Canada, Ottawa.

In two of the oldest provinces of Canada, in Ontario and Quebec, plans for collecting and publishing vital statistics have been in operation for a quarter of a century. Birth, marriage, and death are the chief events in human life, and more than any others they determine the continuity of human society in a civilized state. Therefore, they should be authenticated: there ought to be the most substantial proof of the occurrence of each event as regards person, place, and time. And, as at the first and third a physician is usually present, and at the second and third a clergyman, it is eminently proper that the law should require those professional men, each in his own relation, to attest the facts of which he has personal knowledge. So the physician and the clergyman become in most cases the makers of original records in the field of vital statistics. The law makes this service a duty and an obligation at their hands, and, if in any instance they refuse or neglect to perform it, they are punishable as the law provides. Local municipal officers receive the records, and these officers in turn make reports to the Registrar-General, who gives them to the public in the form we call Vital Statistics once a year, or once in two years, or as often as the law or the government may demand.

In Ontario and Quebec this system works well, and, although provision has been made in some of the other provinces of the Dominion for a scheme of like character, it is not yet in general operation.

Besides these records, an enumeration is made for the whole Dominion once in ten years, in the first year of each decade, when the general census is taken. But this is for mortality only. It is a register by name of every death occurring in the census year, by sex, age, cause of death, conjugal condition, birthplace, origin or race, occupation, and date of death. Births in the census year may also be tabulated from the population and mortality schedules, although such a record is not an original purpose, and I think it would be an improvement if provision was made at future censuses for a full register of vital statistics.

I am not sure, however, if it is possible with the use of the best schedule and under the best system of enumeration, to get a full record of deaths at a census taken at the end of a year in a large country, whether sparsely

or thickly settled. In either case it is not always difficult to dispose of a dead body, if concealment is an object; but a more common cause of failure to procure a record is to be found in the circumstance that the dead are so soon forgotten by the living. Then there are cases when families have moved out of a locality within the year in which losses by death have occurred, and no one is concerned to give the information of death to the enumerator; and there are cases in which, for shame of the event, a death is denied. Even where the law provides that no burial shall take place without a permit and that records shall be supplied to local municipal officers by clergymen, physicians, and others more closely concerned, full returns of deaths are not always procurable. At the census of 1902 we collated our mortality records for Ontario name by name with those of the provincial government, and, after eliminating all duplicates from the two lists, we found about 5,000 names in the municipal records not in the census and about 4,000 in the census not in the municipal records. A similar attempt was made to collate the census and municipal lists for the province of Quebec, but, owing to the practice of the keepers of parish records there to enter married women by their maiden names, the comparison could not be made within the time then available for the task. In the State of Michigan, where corrections of a like sort were made, 10,000 names were added to the census and 2,000 names were found in the census which were not recorded in the State records. Of course, I cannot undertake to say that the latter were correct within a limit of 2,000, but I am disposed to think that the system in use in Ontario is as thorough and as well carried out as the one in Michigan, especially in view of the fact that, whereas the death-rate in Ontario in the census year was 15.24 per 1,000, it was only 13.9 per 1,000 in Michigan.

Another group of statistics may also be compared for a test, remembering that Michigan's census of population was 2,421,000 and that of Ontario 2,182,000. The statistics of some principal causes of death were:—

	Michigan.	*Ontario.*
Consumption	2,438	3,544
Diarrhœal Diseases	2,517	2,517
Diphtheria and Croup	539	750
Influenza	419	649
Pneumonia and Bronchitis	2,647	3,967
Typhoid Fever	680	833
Heart Disease and Dropsy	3,034	2,584

These differences are not easily reconciled when comparison is made of the soil, climate, and sanitary conditions of the two countries. But it should be stated that the classification of diseases was not the same, Canada having adopted for the 1901 census the Bertillon system.

A METHOD OF DEALING WITH UNREGISTERED DEATHS.

By Marshall Langton Price, M.D., Secretary, State Board of Health, Baltimore, Md.

1. *A method of dealing with unregistered deaths.*

Among the most annoying and perplexing of many annoying and perplexing problems with which registration officials have to deal are unregistered deaths. Like the *sine qua non* of the celebrated recipe for cooking rabbits, in order to deal with unregistered deaths, the unregistered deaths must first be found. The efficiency of registration in any registration area will largely depend upon the manner in which unregistered deaths are dealt with.

I shall mention only two methods of practical importance in discovering non-registration of deaths. The first is the census plan. At the time of taking the census full information is collected by the enumerators of the personal particulars, causes of death, etc., of decedents, and the enumerators' returns are then compared with the death records in order to identify the returns and to determine if any deaths are unregistered.

This method has many advantages, but two important objections may be mentioned. First, the information is not immediately available. It is always important to follow up these unregistered deaths at once, especially if violations of the burial permit laws are to be prosecuted. Misdemeanors in Maryland expire by limitation in one year from the time the offence is committed. Second, the evidence is generally hearsay, and applies to events of which it is often impossible to fix the date and which may have occurred more than one year previous to the time of taking the census. On this account deaths which have occurred in families in other States, and the bodies brought home for interment, are frequently credited to the State where burial occurred. Experience shows inaccuracies in the enumerators' returns in other particulars.

The second method is founded upon death notices appearing in the local papers. The latter method has been used recently by Dr. Wilbur to determine the efficiency of registration in the registration areas, and he has found so far that this information is in general more accurate and complete than that obtained by the enumerators. I have found this method such a valuable check on registration of deaths in Maryland that I expect to use it permanently in the future.

The State Board of Health of Maryland subscribes to the three principal papers of Baltimore and fifty-five town and county papers. These papers are sent to the Census Bureau, and clippings of death notices taken out and attached to the standard blank. As soon as these returns are received, they are carefully examined, and deaths outside of the State and in other jurisdictions eliminated. Those remaining are divided into three classes; viz., *possibly not registered*, *probably not registered*, and *not registered.*

A circular letter is then sent to the local registrar. Enclosed with this letter is an inquiry blank. These are filled out in duplicate and cut in two as soon as they are received by the local registrar. One part is retained by the local registrar, and the copy is sent to the proper sub-registrar in the town or county. Upon this blank are returned the name of the person, date, and place of death, and such other information as may be available. The other items of information are the cause of death, date of funeral, name and address of officiating clergyman, name and address of physician last in attendance, name of coroner, name of sub-registrar, name and address of officiating undertaker, place of burial. The last two questions asked are: Reason why permit was not issued, and reason why death certificate was not received?

Excuses like the following were generally for failure to answer these questions: "Sub-registrar away"; "sub-registrar sick"; "no sub-registrar." All of the cases, where necessary evidence was obtained, were prosecuted without regard to extenuating circumstances. Complete evidence can nearly always be obtained in this class of cases by diligent inquiry, and all of the cases brought to trial in this State resulted in conviction.

In many cases the data returned by the local registrar were not of the slightest value as evidence, and in many others were not returned at all. Those cases which fell in the *not registered* class were investigated by the Medical Officer of the Board (Dr. Rohrer).

The method of dealing with unregistered deaths may thus be summarized as follows:—

1. Original information from death notices in local papers.
2. Special information from investigation.
3. Prosecution.

I think I can safely say that on account of this system few illegal interments occur in Maryland without my knowledge, and that this number will be eventually cut down to a negligible figure.

MUNICIPAL REGISTRATION LEGISLATION.

By Charles V. Chapin, M.D., Superintendent of Health, Providence, R.I.

Dr. Wilbur has given me the opportunity of examining the ordinances and other local regulations relating to the registration of vital statistics which his department has recently collected. These ordinances were from fifty-six cities in twenty-five States.

While many of the American colonies made very early efforts to secure a registration of births, marriages, and deaths, it was done for legal purposes, such as the identification of the individual and to assist in the transfer and inheritance of property, there was no intent to secure data for purely statistical purposes. In this early registration the colonies took the lead, the laws were generally those of the colonial assemblies, and local regulations are only occasionally found.

It was different with the beginnings of registration intended for scientific rather than legal purposes. The collection of vital statistics received its first impetus in the towns, where the registration of deaths was desired for sanitary ends. Most sanitary reforms have been the result of startling outbreaks of disease, and the registration of vital statistics which, among many other uses, is of very great sanitary importance, has had a similar origin. The outbreaks of yellow fever, small-pox, and other diseases in the early part of the nineteenth century were doubtless the cause of the demand for the registration of deaths, and, as the cities were the chief sufferers in these outbreaks, it happened that they, rather than the States, were the first to adopt registration. I have not had an opportunity to give personal study to this historical aspect of the subject, but, according to Dr. Edward Jarvis,* New York, began to publish mortality statistics in 1804, Boston in 1813, Philadelphia in 1825, Charleston in 1834, Baltimore in 1836, and Providence in 1841, and Dr. Edward H. Barton,† writing in 1849, says that Norfolk, Savannah, Mobile, and Natchez had provided for the registration of deaths. In none of the States in which these cities are situated was State registration provided for until long after the cities had set the example, and several of the States have not as yet seen fit to do so.

* "Hygiene in America," Bowditch, 1877, p. 172.

† Report of the Sanitary Commission of Massachusetts, 1850, p. 413.

Louisiana was perhaps an exception, as a general registration law was passed in 1811,* but it was never properly executed, and Massachusetts was the first State that really secured a fair registration throughout the State, and that was many years after there had been registration in Boston. But conditions have changed, and at the beginning of the twentieth century we find the State leading in this work. While it is true enough that some cities in non-registration States do excellent work in recording births, marriages, and deaths, it is also true that many of the State laws recently enacted are exceedingly full and comprehensive, prepared with great care, and far better designed to secure good work than are most of the municipal regulations. Much of this advance is no doubt due to the influence of the Federal government in encouraging and assisting in the extension of the registration area, and the excellence of recent registration legislation is the result of the high standard set by the present director of the Vital Statistics Division of the Census Bureau. Hence it is not surprising that but few suggestions can be found in local regulations, and that their best provisions are taken from the recent State laws. We must look to the latter for guidance: the former are of historical interest chiefly.

New York has for a good many years had very good registration, for, although the State law is a comparatively simple one, it requires the return of births and marriages within thirty days, the filing of death returns, and the issuance of a permit before a body may be removed or buried, and this law has been intelligently enforced by the State Department of Health. In none of the cities in New York whose local regulations were examined were found any very valuable additions to the State law, the provisions of which were more or less closely followed by the local regulations. Several of the cities limit the time for making returns to ten or seven days, and in one city the limit for still-births is three days instead of the thirty of the statute. Several provide for the registration of physicians, midwives, and clergymen; one or two require that burial permits shall be returned by sextons and transportation companies; others require a local permit for the burial of bodies brought into the city. One city requires that returns shall be in ink, and in Yonkers the physician or midwife is to leave a blank with the parent for a return of the name of the child. But in the non-registration States of Pennsylvania and Ohio, with the exception of Philadelphia and Cleveland, most of the cities have continued to work under very meagre registration ordinances.

On the other hand there have very recently been some excellent local registration ordinances. Thus Kansas City, Kan., in the early

* Report of the Sanitary Commission of Massachusetts, 1850, p. 411.

part of the present year adopted a well-planned scheme for registering births and deaths.

But, if we can judge fairly from the local legislation examined (and I think we can), it would appear that, on the whole, local regulations are not as complete or as well thought out as most of the recent State laws, and only in rare instances equal the latter, or contain any new and important provisions. Nevertheless, many cities with very scanty legislation have managed to secure excellent registration. Thus, for example, in my own city burial permits were not required until 1864, yet for many years previous, under my predecessor, Dr. Snow, our records of deaths were equalled by few cities. We are forced to the conclusion that, while good registration laws are desirable, it is equally, if not more important, to secure efficient registration officers. If a registration law secures the appointment of good officials, the battle is more than half won.

An examination of the ordinances of the fifty-six cities shows that in all but eight the work of registration is confided to the health officials. This has always seemed to me by far the best plan for cities, and this appears to have been the general opinion. The interest which health officials have in vital statistics, the use which they make of them, and the scientific training which they *ought* to have, should make them something more than mere mechanical collectors and tabulators. In six cities the city clerk, and in one the city recorder, is the registrar.

It is noticeable that twenty-three of the fifty-six cities provide for the registration of marriages by the registrar of births and deaths, in each instance the health official. This seems to be characteristic of local rather than State registration, for in only nineteen of forty-two States are health officials made custodians of marriage records,—a much lower percentage. It seems to the writer very desirable that births, deaths, and marriages should all be recorded by the same officer.

In all but four, and these are unimportant cities, the necessary requirement for the accurate registration of deaths, a permit before burial, is in force. Only nine cities specifically require a permit for bodies brought from other places, though in several others the rules could be so interpreted. Only the very latest rules attempt to designate the duties of the family, the undertaker, and the physician in the preparation of the death certificate, as they are prescribed in modern State laws, but a number of cities do direct that the physician shall prepare or sign the certificate in a specified time. Usually, it is in twenty-four hours, but it is twelve in Raleigh, thirty in Knoxville, thirty-six in New York City and Youngstown, O., forty-seven in Augusta, Ga., and six days in Columbus, Ga. (Burial permits are not required in the latter city.) In three cities the undertaker must obtain the permit

twenty-four hours before burial, and in one city twelve hours before. Fifteen cities provide that sextons and transportation companies shall return all permits to the registrar, thus securing an important check on the returns. Most of the cities make no provision for a certificate for a death which occurs without the attendance of a physician, but about a dozen refer the case to the health officer, and in Mobile it is sent to the coroner, as of course it is in other cities when there is a suspicion of violence. Several cities make the next of kin or the householder equally responsible with the physician for the reporting of a death, or in one or two instances make them responsible only when there is no physician. Only a very few cities make any attempt to secure accuracy in the statement of causes, to specify the data to be reported, the form of the return, or the character of ink or paper, and there are very few specifications for the records. Among unusual provisions may be mentioned that of Mobile, that paupers shall be so designated on the returns, and that of Denver and Cleveland, that two certificates shall be furnished, one of which, properly indorsed, is to be used as a burial permit, In Nashville, if a body is illegally buried, the health officer may order its removal within twenty-four hours.

Nearly all of the ordinances examined provide for the registration of births as well as of deaths and doubtless in some of the others such registration is otherwise provided for. In all of the cities having such provisions the records are to be obtained by reports from physicians and others: in none of them is enumeration provided for either as a primary means of obtaining records or for a check. In every instance the physician or midwife in attendance at the birth is made responsible for the return, and in many instances the parents, next of kin, or relative present, has an equal responsibility, though occasionally the parent is only responsible when the physician fails to make the return. In one city the physician is to leave a birth return with the parent. Very many of the ordinances provide a time limit in which the return shall be made. In four cities it is within one day; in one city, two days; in one, three days; in one, five days; in two, six days; in five, seven days; in four, ten days; in six, thirty days. One city requires that the returns shall be made weekly, another on the first Monday succeeding the birth; two require reports to be made monthly; one on the first of the month, one in the first week of the month, one on the tenth of the month, and one in the first ten days of each quarter. Two cities require the physician to leave a blank with the parent on which the name of the child shall later be returned, if it is unnamed at the time the physician's report is sent in. In Kansas City, when the child is not named, the recording officer is to give the person reporting the birth a blank on which the name is to be reported later.

Many of the cities require physicians, midwives, and clergymen to

keep a registrar of all deaths, births, and marriages at which they officiate, and doubtless the same thing is done without legislation, as in Rhode Island, where birth blanks furnished with stubs and bound in a book are given the physicians and midwives. Many cities have the excellent provision that physicians, midwives, and clergymen shall register their names and addresses with the recording officer.

While local regulations are thus seen to be generally quite meagre, it is doubtless a fact that in many of the cities the registration is excellent because of the interest taken in it by the registrars. Many minor matters, which nevertheless are important, and which are provided for in the more comprehensive State laws, are in these cities equally well attended to by the local registrars, and office rules and customs, under such men, take the place of specific registration.

LIST OF CITIES WHOSE ORDINANCES WERE EXAMINED.

Alabama	Mobile
Arkansas	Fort Smith
Colorado	Denver
Delaware	Wilmington
Georgia	Augusta
	Brunswick
	Columbus
	Macon
Florida	Jacksonville
Illinois	Belleville
	Chicago
	Elgin
	Mattoon
Iowa	Dubuque
Kansas	Kansas City
Kentucky	Lexington
	Louisville
Louisiana	Baton Rouge
	New Orleans
Maryland	Baltimore
Massachusetts	Boston
	Fall River
Mississippi	Natchez
Missouri	St. Louis
Nebraska	Lincoln
	Omaha
New Hampshire	Dover
	Manchester
New Jersey	Hudson
	Montclair
	Morristown
	Paterson
New York	Albany
	Buffalo
	Dunkirk
	Newburg
	Rochester
	New York City
	Rome
	Utica
	Yonkers
North Carolina	New Berne
	Greensboro
	Raleigh
Ohio	Cincinnati
	Cleveland
	Youngstown
Pennsylvania	Johnstown
	Pittsburg
	Scranton
Rhode Island	Providence
Tennessee	Knoxville
	Nashville
Washington	Spokane
	Walla Walla
	Tacoma

THE PRACTICAL COLLECTION OF STATISTICAL DATA.

By M. O. Heckard, M.D., Registrar of Vital Statistics, Chicago.

The scope and power of Registrars in collecting data for mortuary statistics must vary to meet the requirements of their respective communities. The State Registrar views the subject from a purely statistical standpoint, and has not the legal power or means to inquire further. Indeed, he is fortunate if he obtains sufficient information for statistical purposes.

The City Registrar has the same statistical point of interest and two additional: one of the medico-legal and the other of sanitary importance, as prescribed by the laws of his particular locality. Therefore, every death certificate presented to the City Registrar contains three points of about equal interest, and raises in his mind three questions: First, does this certificate of cause of death contain sufficient information for a clear and definite classification? Second, is it sufficiently clear to prevent the concealment of crime or to locate the responsibility if death has been caused by violence? Third, is it sufficiently specific to enable him to make the necessary sanitary precautions to prevent the spread of contagion and properly conserve the interests of public health?

The interests of State and City Registrars are mutual so far as uniformity of collecting and compiling statistics is concerned. There is a wide difference, however, in their methods of obtaining reports of death and means of detecting failure to report. A city whose law requires a permit from the proper officer before a dead body is disposed of in any manner makes possible a complete registration of its deaths; but, before such results can be obtained, the complete operation of the law must be worked out in detail.

I will state briefly the method employed by us and the one that has given the most satisfactory results in our actual work:—

Our city ordinances make it unlawful to remove, bury, cremate, or otherwise dispose of any dead human body until a permit has been obtained from the Commissioner of Health or his duly authorized subordinate. Permission can be granted only upon presentation of a proper certificate of death. Resolutions of the State Board of Health, based upon State law, prescribe what information the death certificate shall contain. The statutes provide that deaths supposed to have resulted

from casualty, violence, or any undue means, shall be referred to the coroner, who alone is authorized by law to inquire into the cause and manner of such deaths. This law precludes the possibility of the return of any great number of unknown causes, the unknown being limited to the cases not recovered until decomposition had so far advanced as to prevent *post-mortem* examination.

After a death certificate is received by the Bureau of Vital Statistics, it passes through the hands of six people and is marked six different times before its final assortment. Being handled by so many clerks for the various purposes, the possibility of its being lost is materially increased. To make loss without immediate detection impossible while in the department, the certificates upon their receipt are numbered, beginning January 1 of each year with Number 1 and running consecutively throughout the year, and the numbers are copied from the burial permits. The closing number for 1906 was 29,048, which represents the actual number of deaths which occurred in Chicago during that year.

The undertaker carries blank forms of the certificate of death which is divided into two parts, the undertaker's report of death and the physician's certificate of cause of death. When called to the care of a dead body, he fills out his report of death, obtaining the information directly from the immediate family, and takes it to the physician who certifies to the cause of death and duration of disease. There are two exceptions to this rule; namely, deaths occurring in hospitals and those returned by the coroner. In hospital cases the entire certificate is filled out in the hospital from information obtained when the patient was admitted, and in the coroner's cases a report is made from the records of his office.

The undertaker in each case takes the certificate of death to the Department of Health, and exchanges it for a burial permit, and the number of the burial permit is written in the upper left-hand corner of the death certificate in ink; then in the right-hand blank space of the certificate the date of issue is marked with a dating stamp.

The name of deceased, age, place and date of death, are then written on a daily report blank, and the serial number is written just above the name. Then with a consecutive numbering machine the serial number is stamped in the upper right-hand margin of the death certificate. The day's certificates are kept together in numerical order, and at the close of each day are checked over by the permit clerk to see that no number is missing, bound together, and passed to the recorder who verifies the count and makes a memorandum of the beginning and closing numder of each day and the total number contained. They are again bounb together and passed to the marking clerk who, after checking back with the recorder, marks the classification (disease) number with blue pencil in the upper right-hand space, makes his daily tabulation of cause of

death, bundles them again, and with his memorandum passes them to another clerk who marks the sanitary divisions of the city with red pencil in the right-hand margin and copies special diseases on cards. From this desk they go to another where a tabulating card is punched and the permit number and initials of the deceased are placed upon the card. Each clerk who handles the certificates checks them with the preceding.

With this system of checking it is impossible for a death certificate, after it once reaches the permit desk, to be lost without immediate detection. If a number is missing, it is only necessary to refer to the daily report to get the name, age, place and date of death, and thus, if necessary, a new certificate.

The burial permit is made with a counterfoil, which bears the same number as the permit. These numbers run consecutively, beginning on January 1 of each year with Number 1, and are printed on the permits. This is the number that is copied on the death certificate. The undertaker, on receiving the permit, fills out the coupon, copying the information from the burial permit. This permit, with coupon attached, is presented by the undertaker to the superintendent of the cemetery at the time of burial. The superintendent signs, dates, and returns the coupon to the department in a stamped return envelope furnished by the department.

The coupons, when returned to the department, are arranged in numerical order, checked with the death certificates and stamped "Interment Verified." They are then placed in filing cases, as permanent receipts for burials.

An annual inspection of cemeteries is made, and the department records of permits are checked with the cemetery records of interments. Thus burials of the dead without proper permit are reduced to the minimum. In the last year there has been but one body removed from the city without the legal authority, and in this case successful prosecution followed.

Every death that occurs in Chicago, whether of a resident or of a non-resident, is counted, including death of every child that has breathed. All visitors who are taken sick and die here, all deaths of non-residents from accident or violence, occurring within the city limits, and all patients who have come to Chicago hospitals for treatment and die here are included in Chicago's death-rate.

On the other hand, residents of Chicago who die elsewhere are not included in our mortality. There is one exception to this rule. Patients who die at the County Institutions at Dunning which is just outside of the city limits, and who were residents of Chicago, are charged back to the sanitary divisions from which they came.

This method of securing returns has proven very satisfactory, so far as

obtaining reports of death is concerned. A definite and comprehensive cause of death is a very different matter, and leaves a great deal to be desired. Many certificates give a long train of symptoms and conditions as cause of death, and in the end omit the disease which was the real cause. Other certificates show two or three diseases without giving their duration, and all of this notwithstanding the fact that suggestions are printed and arranged on the certificate wherever possible. Even with the closest scrutiny of the certificate and the constant use of the telephone, communicating directly with the physician in all doubtful cases, it is difficult at times to make a classification.

The estimated population of our city used in compiling our mortuary statistics is that furnished by the United States Census Bureau.

The registration of births in Chicago has not compared favorably with that of the deaths for obvious reasons. The statutory laws were about the same in their scope and provisions, each being mandatory in character and providing a penalty for failure to report. Each met with the same indifferent treatment from the profession until the enactment of local laws made a comprehensive system of checking on death reports possible. The duty of enforcing this law has been placed upon one who was directly interested in its success. The birth laws have been changed several times and different means employed in an endeavor to secure more complete returns.

The department at one time supplied physicians and midwives with printed postal cards for the return of births, and all the physicians had to do was to write the name of the mother, date and place of birth, and drop it in a mail box. This was certainly as little trouble as a physician could be put to and do anything at all. Under this system Chicago registered its greatest number of births, 29,568, in the year 1900; but what is 29,568 births per annum for a city of about 300,000 women of child-bearing age? Upon receipt of physician's report card the department mailed a blank, containing space for complete data, to the parents, and the birth records were made from the information obtained in this way.

In May, 1903, the State birth law was amended and certificate prescribed, which rendered the card system inoperative. This law provided for the payment of 25 cents for every report of birth, and declared it a county charge, to be paid out of any county funds not otherwise appropriated. This law went into effect July 1, 1903, yet not a fee has been paid for report in our county. The law further divides the responsibility among physicians, parent, and householder, which is sufficient in itself to render it ineffective, and the responsibility of prosecuting for failure to comply with its terms was placed upon the State's attorneys of the respective counties. With this array of disinterested people in charge

it is not at all surprising that our births returns dwindled to 25,171 in 1906, 4,397 below the high point of 1900.

With the yearly increase in population of 58,435 and an annual addition to the school enrolment of 29,701 children, there is certainly room for considerable improvement.

The department, after a thorough consideration of the question, has formulated a plan of action looking toward the correction of the two causes of failure in the past. First, we propose to ask for an amendment to the law, to place the responsibility on an individual, and, secondly, local legislation to provide a means of checking failures to report. The best means of checking reports of births, and one that will at once place it on a par with report of deaths, is a law requiring each child to present a certificate of birth upon entrance at school or upon beginning employment of any kind, and providing a penalty for any teacher or employer who admits any one under twenty-one years of age to school or work until this formality has been complied with.

If we are successful in our endeavor to secure local authority for this, we hope to be able to report favorable progress at our next meeting.

AN AID IN THE SECURING OF RETURNS OF VITAL STATISTICS FROM PHYSICIANS.

By Ernest C. Levy, M.D., Chief Health Officer of Richmond, Va.

That the reliability of vital statistics in any community rests fundamentally upon the promptness, completeness, and accuracy of the reports submitted to the authorities by the physicians is axiomatic. Yet every health officer is painfully aware of the difficulties encountered in getting the doctors to do their part in a thoroughly satisfactory manner.

Upon assuming charge of the Health Department of the City of Richmond in July, 1906, I at once found that we were getting very incomplete returns. So far as certificates of death were concerned, there was no trouble, our ordinances prohibiting the interment or removal from the city of any dead body without a written permit from the Health Department, which permit is issued only on the presentation of a properly executed certificate of death. Returns of deaths were, therefore, complete, at least so far as their actual number was concerned.

In the matter of reporting births and contagious diseases, however, the utmost looseness prevailed, as shown by the fact that the average annual number of births reported during the preceding six years (since which time the ordinance had been in force) was only 685, which was at an annual rate of 7.97 per 1,000. The incompleteness of the returns of contagious diseases was fully evidenced by the enormous ratio which the deaths bore to the reported cases.

In casting about for the best means of correcting this state of affairs, the secret of success appeared to lie in convincing the doctors of the importance of the matter and then in making the reporting of all cases as easy as possible. This was deemed a far better course than endeavoring to correct the trouble by legal procedure. The cordial support of the entire medical profession of a community means everything to a health officer, and no great cordiality can prevail after a doctor has been subjected to the ignominy of appearing in police court before the usual gaping crowd, of being mulcted for even a few dollars of his hard-earned money, and of having his disgrace reported in the newspapers.

The two chief difficulties in the way of getting prompt and complete reports seemed to be ignorance on the part of physicians as to what contagious diseases they were required to report and the fact that they

could not always lay their hands readily on the special form required for making the report.

In order to get around these difficulties, a special outfit was gotten up and distributed to every doctor in Richmond at the end of December of last year. It consists of a pasteboard box, 8 by 10 by 3½ inches, covered with marble paper, and with a let-down front, admitting of easy access to its contents. On the front of this box the words "Board of Health" are printed in gold letters. The whole makes a rather ornamental, certainly not an objectionable, addition to the office equipment of the doctor.*

On the inside of the lid of this box is printed a "Condensed Schedule of the Duties Demanded of Physicians by City Ordinances," under which are stated, very briefly, the laws relating to the reporting of deaths and births, with the penalties for violation, and the law relating to the reporting of contagious diseases and recoveries therefrom, with the penalty for violation. A full list of the reportable diseases is given, printed in prominent black-face type. Finally, there is a direct appeal for co-operation, but this ends with the statement that "when convinced that any physician is systematically violating any ordinances above outlined, it will be necessary to bring such violation to the attention of the proper authorities, and see that the prescribed penalties are enforced."

This box contains a full supply of all forms needed in complying with the ordinances,—birth and death certificates and postal cards for reporting contagious diseases, tuberculosis, and recoveries from contagious diseases. A liberal supply of stamped return envelopes is also enclosed, for use especially in mailing birth certificates, but also for any other official business, the theory being that the doctor should not be put to a cent's expense for doing that which is for the benefit not of himself, but of the Health Department and the community. A final form consists of a special blank (postal card) to be used by the doctor in asking for a new supply of any other form. When this request is received at the office, there is always sent, along with the special forms for which he asked, another of these request forms. In this manner there is never any excuse for a doctor's running out of forms of any kind.

This device has worked admirably, and we are now getting very satisfactory returns. The improvement has not been due to this single factor, of course, since the other methods employed have contributed to that end. Numerous circular letters have been sent to the doctors, and a careful checking system of death certificates has been followed, where the cause of death was any one of the reportable diseases, and also where the decedent was under one year of age. Besides this the

*The boxes were made in Richmond and cost $12.50 per hundred.

sanitary officers are instructed to get full information, when visiting a house for any purpose, as to all infants under one year of age living there. This information is followed up, and many previously unreported births have thus been gotten at, as well as the names of a number of midwives who had not registered with the Health Department as required by law. All these things have contributed to the securing of more complete returns, but it is believed that the outfit described has played an important part. Several other cities, New York among the number, have since adopted the idea.

PRACTICAL WORKINGS OF MICHIGAN'S BIRTH REGISTRATION LAW.

By William F. Petrie, Chief of Division, Vital Statistics, Michigan.

The accurate registration of births, as you all well know, is a subject requiring much consideration, and one upon which much time and thought has been spent in Michigan by registration officials and others. Births were enumerated in the State of Michigan by the supervisors and assessors, beginning with the year 1867, but the results were anything but satisfactory. Probably less than two-thirds of the births that actually occurred in the State were recorded under this system, and the particulars given in regard to the births reported were in many cases incomplete, and some of the statements were incorrect. This manner of reporting births is undoubtedly in vogue in many of your States, and how true the results are is well known to you.

After repeated efforts the Department succeeded in having a law for the immediate registration of births placed on the statute books at the session of the legislature for the year 1905. This law took effect on January 1, 1906, and from the very start has been a success. Like all new laws, however, it takes time to educate the people, and, although much publicity was given to the law, through the press and otherwise, some one is occasionally discovered who has not heard of the law, and seems surprised that they should be compelled to register a birth in their own family.

Considerable trouble was experienced for a few months after the adoption of the law on account of the antagonistic spirit displayed by some of the physicians, who declared that, owing to the fact that a fee was not provided for filing a certificate, the law was unconstitutional, and that they could not be compelled to do something for nothing and consequently would not file a certificate. Fortunately, they were convinced of their error without recourse to prosecution, yet I could see from the manner in which many of the doctors made their reports, that the antagonistic spirit was still there.

While I believe it is considered desirable by some authorities to offer inducements for the return of births by the payment of a small fee for each birth reported, and while it may prove an incentive in some cases, the main reliance for complete returns must rest upon enforcement

of the compulsory requirements of the law. The recent session of the legislature, however, made an amendment to the law, providing for a fee of fifty cents to be paid to the physicians, midwives, or nurses filing certificates of births. This amendment took effect on June 27, 1907, and there is no reason why every birth occurring in Michigan should not be reported, as the chief objection has been removed. The effect of this amendment is very noticeable, as many physicians who were very negligent in filing certificates are now filing their certificates within the ten-day limit.

The filing of the supplementary report of the given name of children was also a problem confronting the Department. The law provides that the report should be made by the physician or person filing the certificate, and in a great many instances the parents were not ready to name their child at the time of birth; and to compel the physician to make extra trips to obtain the name would undoubtedly in many cases work extreme hardship, especially in sparsely settled districts, where long drives would have to be made. Such extra trips were made in several instances by some of our physicians only to learn that the parents were not yet ready to name the child. In view of this fact the Department advised the physicians and others interested to file the certificates and, in all instances where the parent was not ready to name the child at the time of birth, to leave a supplemental blank with them, requesting that it be filed with the registrar as soon as the child was named. This plan has worked very well so far, but in a great many instances registrars have failed to report the names to the Department after being filed by the parent.

To secure the given names on certificates lacking this information for births filed during the year 1906, the Department in November, 1906, sent correction blanks to registrars for all certificates filed in the first six months of the year that lacked this item, and in June of the present year correction blanks were sent for the last six months of 1906. Many names were thus secured, so that the percentage of unnamed children born during the year 1906 and on file in the Department of State is very small. The amendment to the birth registration law, referred to above, requires a sworn itemized statement to be submitted by the physicians and others making claims for fees for certificates filed, and, as this statement is to be filed in the Department, it will undoubtedly contain the Christian names of many children not named on the original certificates, and thus enable the Department to complete the certificate.

There is still another method used by the Department to determine the accuracy of the birth returns; namely, a comparison of the returns of deaths with the returns of births, the ages determining whether a

birth certificate should have been filed since the birth registration law went into effect. This, of course, requires considerable labor, but the results obtained will, I believe, fully compensate for the time spent in checking them up, and many births will be registered that would have escaped registration, had it not been done. This is especially true of still-births, many physicians holding that it is not necessary or important that such births be reported. While not of any real statistical value, it is very important that they be reported, for in many instances physicians, in signing a death certificate, enters in the space provided for the cause of death the word "still-born," and in the space above the words "last saw him or her alive on blank date and that death occurred on date stated above." If they saw the child alive, then the notation "still-born" is incorrect, and it is the practice of the Department to treat all such returns of children as under one year of age for compilation purposes. In every instance where still-births are returned from any district as deaths, examination is immediately made to see if a birth certificate has been filed, and, if none has been returned, the physician is requested to file one immediately.

There is still another check on the returns made to the Department by the different registrars. The law requires that a list of the births filed with the different clerks of the State shall be furnished all supervisors and assessors. These last-mentioned officers are required, when making their annual assessment during the month of April, to make diligent inquiries whether any births have occurred in the families visited by them during the preceding calendar year, and, if they find any and the birth does not appear on the list furnished by the clerk, a certificate of the birth is immediately made out by them and filed with the clerk of the district in which the birth occurred. As a fee of twenty-five cents is provided for every birth certificate filed by these officers, it is reasonable to suppose that the work is done thoroughly and that not many births escape registration. There would be no possibility of any births remaining unreported if the assessors made a house-to-house cavass, as the law requires, but many of them fail to do so, and in consequence some births are liable to escape registration. For the year 1906 there were 224 births returned by the supervisors and assessors, but I do not anticipate that there will be nearly so large a number for the year 1907, owing to the fact that people are becoming better acquainted with the law and that the fee of fifty cents is now provided for the filing of the certificate.

The question may be asked, "Are all births occurring in Michigan registered?" Answering it honestly, I am compelled to say that I do not know. The different registrars of the State are requested to report to the Department any physician, midwife, or parent that fails to file

proper certificates with them, and every month brings many such reports. The Department then takes the matter up, and in most instances the reports are filed promptly, but I presume that a number of births occur throughout the State for which certificates are not filed and no report made to the Department.

For the five years immediately preceding the year 1906 the average number of births returned yearly by the supervisors and assessors under the old law was about 43,000, while for the first year under the new law there were about 60,000 birth certificates returned, which is nearer the correct average of births each year.

The figures published by the Bureau of the Census affirm this view. They give the annual average rate of increase between the years 1900 and 1904 as 27,259. This corresponds so closely to the rate of increase (namely, 28,000), obtained by subtracting the average deaths (about 32,000) from the average number of births (about 60,000) that I am safe in believing over 95 per cent. of the births that occur in Michigan in the course of a year are registered.

TRANSIT PERMITS.

By Franklin C. Gram, M.D., Registrar of Vital Statistics, Buffalo, N.Y.

When transportation companies find that they have a dead body on their hands, after having presumably shipped it to its destination, they begin to inquire into the matter, and usually they find that either through the carelessness of the agent or negligence of the authorities at the starting-point the proper transit permit was not secured. A dead body is unlike ordinary merchandise, which may be held until the neglected bills of lading are secured, and the health authorities at the destination refuse to allow it to remain within their jurisdiction and demand its return whence it came,—naturally at the expense of the transportation company, which ought to have demanded the necessary credentials before accepting it for shipment in the first instance.

No company ever requires a second demonstration of this kind. *One* is usually sufficient to emphasize the point with every official who has charge of such matters. This is the principal reason why transit permits have become a universal necessity. Could transportation companies afford to take the chances, such permits would doubtless be neglected. However, this is not the principal reason from the point of view of the sanitarian and the health authorities.

From an intimate study of many thousands of transit permits received at the Bureau of Vital Statistics in Buffalo, I long ago formed the opinion that the views of the respective authorities who issued them differ about as widely as it is possible for the mind of man to be at variance on any one subject, and still try to accomplish a necessary end. A brief analysis of some of the principal permits on file will make this clear.

Here is a mass of documents accompanying a body from one of the European countries. They include a certificate of death from the attending physician, a certificate from the undertaker and embalmer, an affidavit from a relative, a transit permit from the local authority, a certified translation and other certificates from the American consul, shipping permits, and a certificate on the outside coffin box to the effect that the enclosed body is that of the person which it purports to be. The body is found to be carefully and thoroughly embalmed, then

packed snugly in sawdust in a heavy zinc coffin, which is hermetically sealed and enclosed in a strong outer box with sufficient handles. I have seen such a combination so heavily constructed as to require as many men in handling as could possibly get a hold, while a dray was necessary to convey it from the depot.

Next we have a document issued by a local authority in a certain State, to the effect that the accompanying body died from typhoid fever, which is given as a "non-communicable disease," but the body was, nevertheless, placed in a "hermetically sealed case," and said "hermetically sealed case" was found to be leaking fluids to such an extent that the railroad officials declared they would have refused to carry the body any farther, had it not been so near its destination.

Then comes a permit containing a certificate from the attending physician, with the usual data found on our standard certificate, a certificate from the embalmer, and a proper permit from the local health authority.

Next we have one from a division registrar who certifies that the proper death notice has been filed with him as required by law and permission is granted to "bury or remove" said body; but the permit contains absolutely no information aside from *the name of the deceased.* Indeed, the Grand Trunk Railroad has encountered so many difficulties with the various kinds of permits that it requires a form of its own to be used for all dead bodies shipped over any of its lines. This form embodies the local requirements of all the States and provinces through which the railroad extends.

Transit permits may be defined as *documents issued by the local health authorities at the place from whence a human dead body is to be shipped to some point beyond the jurisdiction of the initial authority.* Their object should be threefold, (1) sanitary, (2) transportation, and (3) statistical. (1) Sanitary, as an evidence that the usual methods prescribed by modern science have been employed in the preparation of the body for shipment; that it is enclosed in an outer and inner case sufficiently safe both as regards the cause of death and the length of time it is expected to be in transit; and that the responsibility for all such preparation is assumed and vouched for by the local health authorities issuing such permit. (2) Transportation, by acquainting the common carrier with the exact condition of the body, its inner and outer preparation, and giving the necessary authority for conveying the same. (3) Statistical, in giving all interested parties, as well as the health authorities at the destination, complete data relative to the deceased, so that an intelligent record may be kept for future use.

The necessity for a standard permit and what it should contain is a subject which, it seems to me, the American Public Health Association

has persistently overlooked, at least it has failed in accomplishing adequate results. It is a pertinent matter for the Section of Vital Statistics to deal with, because its members are more intimately acquainted with the various points involved, and have learned by experience what is essential. Why are standard permits necessary? As said before, there is no uniform system at present. Hardly any two States have similar forms, and we are aware that even in the same State a multiplicity of forms exist. We are also aware that some localities have receded from the advanced stand they had taken because of the pressure brought by the undertakers' association, who claimed that certain requirements were against their interests. We know that some State authorities take the advice of undertakers in preference to that of the physician or sanitarian, when about to make any contemplated change in any subject in which both are interested.

Standard forms for transit permits are as essential as standard death certificates. There should be a uniformity in such matters throughout the jurisdiction of this association. They should be divided into four parts, or certificates, forming one blank. The first part should contain a doctor's or coroner's certificate, signed by the same person issuing the death certificate for filing at the local health office, and containing data similar to our present standard death certificates. Concerning this there is a difference of opinion. It is used by some States, and has been required and again discarded by others. The greatest objection which I have found came from the undertakers, who claimed that it imposed extra work by requiring them to have the attending physician fill out this blank. This is hardly a tenable reason, since the physician's certificate of death must be obtained and filed before a transit permit can be obtained, and the extra labor involved in securing this duplicate for the transit blank is not worth mentioning. The benefits, moreover, more than compensate. We are constantly learning by experience that this very evidence may be as important at the point of destination as it is at the initial point, besides giving a complete record at the former, the place where the body is to rest permanently.

The second part should contain a certificate from a licensed embalmer, certifying how the body had been prepared for shipment. This is perhaps the most important feature, and should be rigorously enforced. Inasmuch as some might get the impression that this certification is a mere matter of form, a sufficient penalty should be imposed and the license revoked if an embalmer is convicted of falsifying such a document. All depends upon the honesty of the undertaker in these cases. Certain methods of preparing bodies for shipment should be prescribed and embodied into rules, to be printed on the back of all transit permit blanks, for the information and guidance of interested parties. It is

obviously impossible for health commissioners or registrars of large cities personally to inspect all shipping cases before issuing a transit permit, and for that reason the undertaker who is found to have misused the confidence placed in him should be severely dealt with.

After the doctor and the undertaker have certified to their respective portions, then the health authorities should officially vouch for such correctness and sanction the removal of the body. This should form the third part. The last division of the blank should be left for the transportation companies.

Should transit permits be issued in duplicate? I would unhesitatingly answer this question in the affirmative. Experience has demonstrated that much delay and annoyance is caused by the loss of a transit permit. One copy should be pasted on the outer box, and the other given to the person in charge of the body.

The transfer of disinterred bodies is an important matter which needs attention. Some States have made proper provision, others have rules which they do not enforce. It is no common occurrence for a disinterred body to arrive at a place, in violation of local or State laws, while the health authorities are told that "the body is here, what are you going to do about it?" To compel its return would involve legal difficulties. To prevent its burial would turn the sympathies of the community against those who are striving for a principle. Then, again, the shipment may have been made in conformity with the rules of the locality where the body was disinterred, these rules being at variance with those at the point of reinterment. At all events, the same law would not govern in both instances, and therefore would be difficult of enforcement. For these and other reasons, before a body is permitted to be disinterred, the consent of the State Board of Health and of the Board of Health at the point of destination should be obtained, after which disinterment and shipment may be allowed under sanitary restrictions.

Whenever shipment is made in death from a communicable disease, telegraphic notice should be sent to the health officer at the destination thereby enabling him to take any measures necessary for local protection. It may be used also as a check on the manner in which the body was prepared and shipped.

In examining many transit permits, I find the same diseases placed in the communicable as well as the non-communicable class, evidently showing a difference of opinion as to where they belong or ignorance on the part of the person who made the designation. It is therefore essential to have an understanding as to this classification, with a view to securing uniformity. When this list is determined, it should be printed on the back of the standard transit blanks.

What is an hermetically sealed case? Manufacturers of caskets

would answer this question to suit their individual efforts. Iron, zinc, grooved, rubber-lined, locked, and many other styles of cases have been "guaranteed" as hermetically sealed, but found to be wofully wanting when put to proper test. It should be uniformly understood, and so designated in the rules, that no coffin is considered as "hermetically sealed" unless it is made of copper, zinc, or heavy tin, and all seams carefully soldered.

Most forms of transit permits now in use are encumbered with several coupons, for the existence of which I have never been able to find the ghost of an excuse. Registrars are familiar with these vermiform appendixes, and it would therefore be a waste of energy to describe them. The very fact that not a single coupon meets with its intended use, but remains a part of the original blank, is sufficient evidence of its superfluous nature.

THE DEATH-RATE OF THE CITY OF NEW YORK AS AFFECTED BY THE COSMOPOLITAN CHARACTER OF ITS POPULATION.

By William H. Guilfoy, M.D., Registrar of Records, New York City.

This study was suggested by the "marking-time" during the past few years in the progress of the death-rate of the city toward an expected lower level. In seeking the causes of this halt in a hitherto uninterrupted decrease, the writer became impressed with the significance of the part played by the influx of the immense number of immigrants from continental Europe. In a community of four and one-quarter millions of people (a fair estimate of the population of the city) it is reasonable to suppose that the presence of one and three-quarters millions of aliens would appreciably affect the death-rate of the community, especially when we consider that the customs, habits, and environment of fully 80 per cent. differ widely from the requisites for the making of a healthy member of the body politic. During the fiscal year ending June 30, 1907, the number of aliens arriving at the port of New York was 1,004,000, and of that immense number only 50,000 were credited to Great Britain and Ireland. Well might the student of political, social, and hygienic economy ponder over the question of the assimilative capacity of the country at large and of the urban communities in particular!

The crude death-rate, as ordinarily used in comparisons of cities and countries, is, as you all know, a much-abused weapon of offence and defence, but in the comparison of a city's hygienic progress or retrogression with its own past it may be depended upon, provided no great change has taken place in the population as regards age, sex, or occupational conditions. An application of standard death-rates at a series of age-groups was made to the population of the city as ascertained by the censuses of 1875 and 1900, and it was found that the resulting difference did not exceed one-tenth of one point per thousand. Therefore, it seems allowable to use the crude death-rate of this city as an index of the prevailing sanitary conditions, and an analysis of the factors affecting its increase or decrease may be indulged in.

In analyzing the following tables, we must not at any time forget that all conclusions are, of necessity, more or less tentative by reason of

TABLE I.

DEATHS AND DEATH-RATES PER 100,000 ACCORDING TO NATIVITY OF DECEASED IN OLD CITY OF NEW YORK, 1906.

CAUSE OF DEATH.		POPULATION AND NATIVITY.													
		Total.	United States.	Ireland.	Germany.	Italy.	Russia-Poland.	England.	Austria-Hungary.	Scotland.	British America.	Switzerland.	France.	Bohemia.	Sweden.
		2,464,432	1,551,854	198,028	231,050	104,954	134,714	49,283	73,920	14,602	15,550	6,382	10,952	10,951	20,077
All Causes	Deaths	46,108	28,067	5,795	3,966	1,906	1,824	852	1,227	276	239	157	256	204	225
	Death-rate	*1871*	*1849*	*2926*	*1717*	*1816*	*1354*	*1729*	*1660*	*1890*	*1537*	*2460*	*2337*	*1863*	*1121*
Typhoid Fever	Deaths	369	208	41	22	32	8	8	21	2	2	1	5	2	4
	Death-rate	*14.9*	*13.7*	*20.7*	*9.5*	*30.4*	*6.7*	*16.2*	*28.4*	*13.7*	*12.9*	*15.7*	*45.7*	*18.3*	*19.9*
Pulmonary Tuberculosis .	Deaths	5,900	3,156	944	434	290	224	112	246	52	30	36	34	48	47
	Death-rate	*239.4*	*207.2*	*476.7*	*187.8*	*276.3*	*172.4*	*227.3*	*332.8*	*356.8*	*192.9*	*564.2*	*310.4*	*438.3*	*234.1*
Cancers	Deaths	1,856	563	330	351	69	172	69	112	22	24	12	18	27	17
	Death-rate	*75.3*	*37.1*	*166.6*	*151.9*	*65.7*	*132.9*	*140.0*	*151.5*	*150.7*	*154.3*	*188.0*	*164.3*	*246.0*	*84.7*
Heart Disease	Deaths	3,506	1,320	755	535	169	222	102	141	31	27	19	37	26	14
	Death-rate	*142.3*	*86.9*	*381.2*	*231.5*	*161.0*	*170.0*	*207.0*	*190.7*	*212.3*	*173.6*	*297.7*	*337.8*	*237.4*	*69.7*
Broncho-pneumonia . .	Deaths	3,379	2,875	145	99	113	43	18	24	11	5	7	8	3	2
	Death-rate	*137.1*	*189.4*	*73.2*	*43.2*	*107.7*	*54.2*	*36.5*	*32.5*	*75.3*	*32.2*	*109.7*	*73.0*	*27.4*	*10.0*
Lobar Pneumonia . . .	Deaths	3,303	1,750	572	294	232	108	70	80	29	23	9	23	10	18
	Death-rate	*134.0*	*116.3*	*288.8*	*127.2*	*221.1*	*83.9*	*142.0*	*108.2*	*198.6*	*147.9*	*141.0*	*210.0*	*91.3*	*89.7*
Chronic Bright's	Deaths	3,232	1,205	812	491	113	155	99	97	33	36	13	26	28	20
	Death-rate	*131.2*	*79.4*	*410.0*	*212.5*	*107.7*	*121.0*	*209.0*	*131.2*	*226.0*	*231.5*	*203.7*	*237.4*	*255.7*	*99.6*

the entire absence of age-grouping among the different nationalities and races comprising the population of the city. The presence of such a grouping is almost a *sine qua non* in the discussion, and the means taken to provide a substitute therefor, poor though it may be, consists in the preparation of tables of deaths and death-rates from certain causes and in certain districts, the causes being those that affect chiefly certain age-groups, and the districts such as are typical of certain nationalities, races, and age-constitution, thus enabling tolerably fair conclusions to be arrived at.

In Table I are shown the deaths and death-rates per 100,000 from all causes and from certain prominent causes by nativity of descendants in the old city of New York (present Boroughs of Manhattan and the Bronx) for the year 1906. At first glance at the general death-rate column it would seem, if we compare the death-rate of *1849* per 100,000 of persons born in the United States with that of *1871* per 100,000 for the entire city, including all nativities, that there is very little effect produced on the rate by the mortality among the foreign element, but it must be borne in mind that, of 28,067 deaths attributed to the United States, only 10,080 had American parents, the rate among the latter being about *1440* per 100,000, the remaining 18,067 deaths of natives born of foreign parents producing a rate of *2256* per 100,000. This low mortality of *1440* per 100,000 among the native Americans and immediate descendants of native fathers and mothers and the high rate of *2256* among descendants of foreigners might be accepted and conclusions drawn therefrom, provided assurance could be given that the age-periods of these two groupings of the population were approximately the same; but this is not the case. The greater fecundity of the alien produces an undue proportion of children in that group under five years of age, and naturally a higher general death-rate is the result. The difference between the two rates is so great, however, that unequal age-constitution does not account for all of the increase. Density of population, sanitary surroundings, personal habits and cleanliness, poverty, etc., play a most important part in increasing the mortality among the descendants of aliens.

The general death-rate of the natives of each country specified in Table I is instructive, though in the comparison of one with the other it is open to the same objection; namely, the lack of specific figures as to age-constitution. The Irish lead with a rate of *2926*, while the Swedes apparently are the healthiest, with the low rate of *1121*. The high rate among the former is *partly* explainable by the fact that between 1847 and 1893, a period of forty-six years, the influx from Ireland was immense and constant, while for the past fourteen years the numbers have been small in comparison, thus producing an Irish population in this

city whose age distribution, especially at ages fifty and upwards (assuming the average age of each immigrant to be twenty-five years), is favorable to an exceedingly high death-rate, and the low death-rate among the Swedes being partly explainable by the fact that immigration from Sweden began at a comparatively recent year (1885), and that there is, as a result, a preponderance of adults at ages between twenty-five and fifty, at which ages the normal death-rate ranges between 10 and 12 per 1,000. What has been said of the Swedes is true of some of the other nationalities; for example, the Italians, Russians, Poles, and Hungarians.

In considering the mortality from typhoid fever in this table, remembering that this is a disease that attacks all ages, we find that, omitting those nationalities where the deaths do not number twenty or over, the Italians and Austro-Hungarians present the highest rates. This is what we might naturally expect by reason of the well-known unsanitary personal condition of these classes. The Germans and the Russian Poles, on the other hand, afford the lowest rates, the reason in the case of the Germans being the habitual cleanliness of this nation, and of the Russian Poles the prevention of direct infection by the removal of most cases among them to hospitals for treatment.

Interesting indeed are the figures presented in the table of the mortality from pulmonary tuberculosis. Switzerland leads the list with a rate of *564*, Ireland comes next with *476*, Bohemia follows with *438*, then Scotland, Austria-Hungary, and Italy follow in the order named, Russia-Poland bringing up the rear with the comparatively low rate of *172*. Disregarding the Swiss, who number only a little over 6,000 and taking up the rate among the Irish, we are confronted with the remarkable rate of nearly *500*. This is partially explained, as already noted in commenting upon the higher general death-rate among the native Irish, by the unfavorable age-grouping of the Irish population. The average age at death of the Irish from this disease, based upon two hundred deaths reported, was found to be forty-two years, while the average age at death among the entire population, based upon eight thousand deaths attributed to this cause, was thirty-six years. It is noteworthy in this connection that the death-rate from this disease in all Ireland in the year 1905 was only *204*, the rate among the Irish in this city being almost two and one-half times that in their native country. It is hard to believe, therefore, that this high rate is dependent entirely upon a national predisposition. It is true that we should expect an increase by reason of the comparatively severe climate and the absence of the pure air of the home country, but this is in a measure offset by the more abundant and nutritious food to be had here.

As regards the next cause, cancer and sarcoma, all the natives of foreign countries except Italy and Sweden show a rather high rate, the natives

of the United States showing the lowest rate. Apparently, the contention that excessive meat-eating and the drinking of spirituous liquors are the predisposing factors in the causation of the ever-increasing mortality from this disease is upheld when we consider that the foreign nations, with the exception of the two above mentioned, are in the category of the large meat-eaters; but this conclusion must not be too hastily jumped at, as the age distribution has much to do with the mortality from this disease which does not assume a prominent place in the mortality list until the age of forty has been reached.

In considering the mortality from organic heart disease and chronic Bright's disease, the most remarkable thing to be noted is that every nationality having a high mortality rate from cancer has a correspondingly high rate from these two diseases. A glance at the table will show that this coincidence is very evident. What has been said concerning cancer is true of these two causes also, and, furthermore, it should be borne in mind that these three causes have during the last fifteen years increased to an alarming extent.

Table II, which shows the deaths and rates for the same countries and periods as Table I, is based on the nativities of the *parents* of the deceased. The general death-rate column as compared with that of Table I presents a number of changes; for example, the mortality of those whose parents were born in Italy—that is, Italian-Americans, so-called—reaches the extremely high mark of *3643* per 100,000, or 36.43 per 1,000. The previous table shows that the rate among the native Italians is less than one-half as great. The rate for native Austro-Hungarians, *1660* per 100,000 in Table I gives way to one of *2340* in Table II. On the other hand, the mortality rate of *1849* per 100,000 for native Americans is superseded by a rate of *1398* per 100,000 for the descendants of native Americans; and the rate of the Irish-born, 2926 per 100,000, gives way to that of *2355* among the Irish-Americans. In analyzing these rates, the disturbing element is the fecundity of the different nationalities with its influence upon the mortality rates. Natives of the following countries have comparatively low birth-rates, and consequently their general death-rates in Table II show considerable decreases,—the United States, Ireland, Germany, England, Scotland, British America, Switzerland, France, Bohemia, and Sweden. On the other hand, considerable increases are shown in those nationalities noted for their opposition to the race-suicide tenets, namely, the Italians, Russian-Poles, and Austro-Hungarians. The birth-rates among the natives of these countries domiciled in the city have been exceedingly high (probably 32–35 per 1,000) during the past five years, and in consequence the number of children under five years of age is large compared with the number of children of corresponding age among the other

nationalities, and, as the mortality is very high at these ages, we naturally are not surprised at the resulting high death-rates.

Table II in the main corroborates the deductions drawn from Table I as to the mortality of the different nationalities from the causes specified. Thus in the typhoid fever column, omitting nationalities whereof the number of deaths does not reach twenty, the Italians and Austro-Hungarians have the highest mortality, while under the heading Measles we notice that the Italian children have a mortality rate almost five times that of the entire city. The Italian children show the highest mortality also from scarlet fever and whooping-cough, with the Hebrew children a close second; and neglect of the use of diphtheria antitoxin results in a mortality rate from diphtheria among the Italian children of three times that of all other nationalities combined, while among the Hebrew children the rate is almost twice that of the normal average. The mortality from pulmonary tuberculosis, shown in Table II, exhibits the same general features as in Table I, the Swiss, Irish, French, Bohemians and Scotch having death-rates much higher than the normal average. The rates from cancers, organic heart and chronic Bright's diseases, are all lower in Table II than in Table I. This is doubtless due to the fact that these diseases usually attack only those of middle life and advanced age, while the rates are figured on all ages, including young children as well as adults, thus giving lower mortality figures. Under the rates from broncho-pneumonia the most surprising figures of the whole table appear, the rate among Italian children reaching the enormous height of *710* per 100,000, more than 7½ times as high as that among American children. When we consider under what conditions the Italian families herd together, and the opportunities thus afforded for the spread of contagious and infectious diseases, the difficulties encountered by the sanitary officers can be imagined, but not described. Think of seven tenement houses with a population of 1,500 and of a square block that by actual count harbors 5,100 souls, surrounded by other blocks harboring an average of 2,000, and you obtain an idea of the necessity for eternal vigilance on the part of the health officials. The lobar-pneumonia column affords added proof of the Italian national predisposition to diseases of the respiratory tract. Here the Italian leads, with none of the others a close second. The mortality from the diarrhœal diseases impresses upon the medical profession the necessity of promoting the campaign for pure milk and food, and of using our best efforts to advance the worthy cause of a clean milk supply for our large cities with their teeming tenements. The death-rate from this cause among Italian children is double that of the Austro-Hungarian children, and three times as high as the average for the entire city.

All Causes

Typhoid F

Measles .

Scarlet Fe

Whooping

Diphtheria

Pulmonar

Cancers .

Heart Dis

Broncho-p

Lobar Pn

Diarrhœa

Chronic B

TABLE III.

DEATH-RATES PER 1,000 IN CERTAIN TYPICAL BLOCKS, OLD CITY OF NEW YORK, 1906.

Block.	Type.	General Death-rate.	Pulmonary Tuberculosis.	Cancer.	Heart and Bright's.	Lobar Pneumonia.	Bronchopneumonia.	Diarrhœal Diseases.
A.	Negro	38.56	8.64	0.66	4.66	2.00	5.99	2.66
B.	Syrian	35.83	3.91	1.96	1.30	4.57	3.91	3.91
C.	Chinese	34.65	12.47	0.69	5.54	3.46	0.69	—
D.	Irish	24.64	4.78	—	5.05	0.67	1.91	2.70
E.	Bohemian . .	19.57	4.10	1.82	3.19	—	1.82	1.37
F.	Italian	19.26	0.96	—	1.74	0.96	8.29	2.31
G.	Russian Polish.	17.47	0.83	0.83	1.94	1.94	1.94	1.11
H.	Austro-Hungarian	16.43	1.21	0.72	2.17	1.93	1.93	1.93
I.	German . . .	16.30	1.48	2.22	2.96	—	0.74	1.48
	General rates entire city . .	18.71	2.39	0.75	2.74	1.34	1.37	1.48

The third and last table to which your attention is directed shows the death-rate per 1,000 from certain diseases and all causes in selected blocks typical of some of the nationalities and races. These blocks, situated in congested areas of the city, have populations of from 1,400 to 5,100 persons to the block. The influence of the negro's presence upon the mortality rate is more or less familiar to all, and is clearly shown in the table. The general rate, 38.56 per 1,000, of the selected negro block (A), "San Juan Hill," is more than double that of the city at large, while the rate from pulmonary tuberculosis is three and one-half times as high as the average for the city, and is only exceeded by that of the Chinese block. The mortality from organic heart, chronic Bright's, pneumonial, and diarrhœal diseases, is also excessively high. Throughout the Greater City the mortality among the colored population is 27.16 per 1,000 as against a rate of 18.19 among the whites and a general death-rate of 18.35, the effect of the negro population being to increase the general rate by .16 of a point. The recent addition to our community of the Syrian and Armenian section bids fair to affect detrimentally the mortality rates. The general rate of 35.83 per 1,000 here (B) is almost equal to that of the negro block, and the mortality from cancer, pneumonial and diarrhœal diseases is greater than that among the negroes. The Chinese block (C) contains about 1,450 Chinamen and is noted for its high death-rate from pulmonary tuberculosis as well as for

its unsavory police record. The general rate is 34.65 per 1,000, and the rate from pneumonia is almost as high as that of the Italian block. The Irish block (D) shows a high general death-rate and a high rate in all diseases preponderating at middle or advanced ages. The Bohemian block (E) shows a moderately high general death-rate and excessively high rates from pulmonary tuberculosis and organic heart disease. The Italian block (F) shows a general rate slightly above the average, but the highest rate from the pneumonias. The Russian-Polish block (G) shows a low general rate, with a pneumonia death-rate somewhat above the average. The low rates in this block and among the Jews throughout the city can be ascribed to several causes. Although living in densely populated sections, the Jew by reason of his temperate habits and his inherited vitality is able to resist and overcome infection, or, as has been said, the Jew is physically "tough" in the best sense of the term. Again the present status of the Jew as to age distribution at most age-periods, with the exception of that under five years, is favorable to a low death-rate. The Austro-Hungarian block (H) makes a very presentable showing, the general rate being almost the same as that shown in Table I. The German block (I) shows the lowest general death-rate, the only rate much above the average being that from cancer.

The conclusions forced upon us by the consideration of these tables are that the natives of Ireland by reason, in great measure, of their unfavorable age-grouping increase the general mortality, and the same is also true to a lesser extent of the natives of France, Switzerland, and Scotland. The natives of Italy, Bohemia, and the United States are credited with a rate almost the same as that of the general average of the city, while the natives of Sweden, Germany, Russia-Poland, Austro-Hungary, and England affect favorably the general mortality. On the other hand the immediate descendants of the Irish, Italians, and Austro-Hungarians are instrumental in increasing the general rate, and especially the rates from certain preventable and infectious diseases. The immediate descendants of most of the other nationalities, including Americans, serve to lower the general rate.

APPENDIX C.

PROPOSED RESOLUTIONS (RULES OF STATISTICAL PRACTICE) PRESENTED AT THE FIRST ANNUAL MEETING OF THE AMERICAN PUBLIC HEALTH ASSOCIATION: SECTION ON VITAL STATISTICS, AT ATLANTIC CITY, N.J., SEPT. 30 TO OCT. 4, 1907.

NOTE.—Each proposition should be considered on its merits. It is not to be understood, from the mere fact of presentation, that the Bureau of the Census either does or does not advocate the adoption of any individual item. In some cases, references may be given to accepted modes of treatment or a specific recommendation. However simple and obvious some of the propositions may appear, there is not one of them upon which there is a strict agreement among American official statistical publications at the present time. Hence the necessity for definite decisions.

(1) STATEMENT OF CAUSE OF DEATH.*

1. That a uniform mode of statement of causes of death upon certificates of death shall be adopted by all registration offices in the United States which shall provide, first, in the case of a death from disease, for the name of the DISEASE CAUSING DEATH, and, in the case of a death from violence, for the MEANS OF DEATH, AND WHETHER ACCIDENTAL, SUICIDAL, OR HOMICIDAL; together with such subsidiary information, if any, as may be necessary, under the head of "resulting in" or "aided by."

2. That a continuous and systematic effort be made, through the conjoined action of the local, State, and government authorities, to secure the co-operation of physicians and coroners in the more definite and satisfactory statement of causes of death; and that for this purpose each certificate of death bear a certain minimum amount of suggestions in regard to the statement of cause of death, which shall be uniform throughout the United States, in addition to any special instructions or regulations required for local use.

As a basis for discussion in regard to what this minimum amount shall be, the following draft of suggestions, which can readily be inserted upon the reverse side of any certificate or printed on the inside of the cover of the booklet of blanks supplied to physicians and coroners, has been prepared:—

(DRAFT OF) SUGGESTIONS TO PHYSICIANS AND CORONERS RELATIVE TO THE STATEMENT OF CAUSE OF DEATH.

(Adopted by the American Public Health Association and recommended by the United States Bureau of the Census for the purpose of securing uniformity in returns of deaths throughout the United States.† *Please read carefully.*)

A. *Deaths from disease.*

1. Name, first, the DISEASE CAUSING DEATH. What is wanted is the name of the *disease* (or malformation) itself responsible for the death; *not* a mere secondary, consecutive,

* See full text of census pamphlet No. 107, "Modes of Statement of Cause of Death and Duration of Illness upon Certificates of Death," which is submitted as a part of this recommendation.

† Provided, of course, that any definite instructions can be generally agreed upon.

contributory, or immediate cause, complication, symptom, terminal condition, or mode of death. Never report a death from such "causes" as asphyxia, asthenia, collapse, coma, convulsions, debility, dropsy, exhaustion, heart failure, hypostatic pneumonia, inanition, marasmus, old age, shock, syncope, or weakness, if a definite disease causing the condition can be named. WAS IT PUERPERAL? Always qualify, as *puerperal* convulsions, *puerperal* peritonitis, *puerperal* septicemia, etc., all deaths resulting from childbirth or miscarriage.

2. *Important* secondary affections or independent (concurrent) diseases actually contributing to the death may be named.

Example: Measles (disease causing death); broncho-pneumonia (secondary affection).

B. *Deaths from violence.*

1. Name, first, the MEANS OF DEATH, and whether ACCIDENTAL, SUICIDAL, OR HOMICIDAL; as, *accidental drowning, suicide—carbolic acid; railroad collision.*

NOTE.—In the last example, it is not necessary to write "Accidental," because such cases are *plainly* of that character. A judicial determination of "manslaughter" on account of negligence does not affect the *statistical* character of the return, and a coroner should not delay the filing of the certificate of death on that account.

2. Nature of injury (lesion) or immediate cause of death may be given if not implied under (1).

3. Important *secondary* affections (*e.g.*, erysipelas, septicemia, tetanus) and contributory diseases (*e.g.*, insanity, alcoholism) should always be stated.

As an example of how such data might be provided for with but slight modification of the standard blank, the following form is submitted:—

MEDICAL CERTIFICATE OF DEATH

DATE OF DEATH

.... 19.....
(Month) (Day) (Year)

I attended deceased from.....19....

to.....19....., I last saw h.....alive on

.....19....., and I HEREBY CERTIFY

that death occurred on the date above at.....M. The DISEASE

CAUSING DEATH [*or* ***MEANS OF DEATH**** (Deaths from violence)] was:	Duration in Years, Months, Days, or Hours.
Resulting in:	
or Aided by:.....	

(Signed).....M. D.

.....190.....(Address).....

*State how injury occurred and whether { Accidental? / Suicidal? / Homicidal?

Duration.

Enter duration, in years, months, days, *or* hours, after each separate cause of death. Duration of a disease is from its commencement until death occurs; do not merely give time of final illness in chronic diseases. Duration in deaths from violence is from the time of injury or appearance of complication until death.

(2) Statement of Occupation.

Note.—In census pamphlet No. 107, "Modes of Statement of Cause of Death and Duration of Illness upon Certificates of Death," the following statement is made (p. 8):—

"*Occupation.*—While this item should afford some of the most practically useful information derived from mortality statistics, it does not do so at present. A complete study of the subject by an authorized committee, and with the aid of all who are interested in statistics of the mortality of occupations, should be made and an improved schedule formulated, if one not too cumbrous can be devised, that will enable a beginning to be made in the collection of satisfactory material. A form will be submitted merely as a basis of discussion, and so that definitive action *may* be taken in 1908 without waiting another year for the report of the special committee in charge of the subject. It is desirable that all changes in the standard blank be made at the same time. In the meantime it is urged that special attention be given to the subject by statisticians. A symposium on 'Occupations' is planned in the American Statistical Association, in which the requirements of the schedule and instructions on occupations may be discussed from the several points of view of population, industrial (manufactures) and vital statistics."

There is little variety in the form of this question upon certificates of death employed in this country, nearly all of them asking for the simple statement of "Occupation," as in the standard blank:—

OCCUPATION

1. An attempt should be made to secure not only the kind of occupation (*e.g.*, laborer), but also the kind of industry (*e.g.*, pottery).
2. For satisfactory statistics of occupational mortality, it is desirable to know the length of time employed from beginning the occupation until death.
3. In case of a recent change of occupation (————* years before death), it is desirable to know the previous occupation, which may have been the cause of change to a lighter employment and the predisposing cause of death.
4. For persons unemployed it may be important to know the last previous employment (————* years before death), as this may have contributed to invalidism or retirement, and may have been a contributing cause of death.
5. Instructions in regard to the reporting of occupations should be uniform in population, industrial and mortality schedules (certificates of death), and uniform instructions should be prepared for physicians and local registrars, and enforced by State registration offices, on this basis.
6. Occupations should be stated for all decedents over ten years of age (and for decedents under ten years of age if employed in a mill, factory, or in any gainful occupation).
7. For children under ten years of age the occupation of the father (or of mother, if not supported by father) should be obtained on account

* Time limit to be determined.

of the great value of such information for a proper study of infant and child mortality.

NOTE.—If deceased has been employed in above occupation for less than ————* years, please fill out statement of LAST PREVIOUS OCCUPATION on reverse side. The complete and correct statement of occupation is most important, and informants, or physicians, are requested to make a precise statement. Local registrars should see that the blank is properly filled out in this respect.

OCCUPATION (Last gainful occupation; if under 10 years, that of FATHER)

..... From.....
(Kind of work? Trade? Profession?) To.....
(Years only)

.....

(Employed in what kind of business, mill, factory? On farm, railroad, etc.)

(3) STATISTICAL DEFINITION OF DEATHS.

1. Total deaths, as stated in mortality reports and bulletins, should include *all deaths* that occurred in the area of the State or city during the specified time.

Still-births.

2. Still-births should not be included in deaths.

NOTE.—Still-births may be *registered*, of course, either separately as still-births, as births or deaths, or preferably as both births and deaths. These rules have no bearing upon the method of collecting the returns, but relate solely to the statistical presentation of the data.

3. Children born alive and *living for any time whatever*, no matter how brief, after birth, should not be classed as still-births, even though reported by the attending physicians or midwives as "Still-born."

4. Whenever age, in days, hours, or minutes, is reported for a "Still-born" child, or indicated by difference between dates of birth and death, the registrar should secure a statement that will enable the case to be classed with certainty either as a still-birth or as a death. If no additional information can be obtained, the statement of age should govern, and the case be compiled as a death, not as a still-birth.

Premature Births.

5. Premature births (not still-born) should be included in total deaths (classified under International Title No. 151).

6. Premature births (still-born) should be classed under still-births, and should not be included in total deaths.

7. When a premature birth is reported as "Still-born" and an inconsistent statement of age (days, hours, minutes) is also given, the registrar should endeavor to secure a statement that will enable the case to be classed with certainty either as a still-birth or as a death. If no additional information can be obtained, the statement of age should govern, and the case be compiled as a death, not as a still-birth. (See also following paragraph.)

8. In the above case of inconsistent statement of "Still-born" and

* Time limit to be determined.

age, if the period of utero-gestation is also given and is under seven months, then the case should be classed as a still-birth.

9. When a premature birth is reported with no statement of age (space left blank), the local registrar should endeavor to obtain a statement of age, or at least that the child was born alive; but, in absence of any further data, the case should be compiled as a still-birth.

Deaths of Non-residents.

10. All deaths of transients or non-residents occurring in a State or city should be included in the tables of total deaths.

NOTE.—It is not fair to exclude non-residents *unless* all deaths of residents occurring elsewhere can be included: this is quite impracticable in the United States under present conditions and the large extent of non-registration territory. No rules based on duration of actual residence of transients or nature of cause of death have been generally adopted, so that deaths of a certain character would be uniformly excluded. It is evident that the death of a non-resident of a city who succumbs to typhoid fever after living there long enough for the time to include the duration and period of incubation of the disease should be properly charged to its mortality. On the other hand a death from pulmonary tuberculosis occurring within 1, 2, 3, . . . months after arrival, may not be properly chargeable to the mortality of the State or city. As a provisional method of treatment, the following paragraph is submitted:—

11. A separate column showing "Deaths of non-residents" may be given, which should include deaths in hospitals, institutions, and of transients and non-residents, on whose certificates of death appears a statement of "Former or usual residence," "Where was disease contracted, if not at place of death," and "How long at place of death," the time stated in answer to the last question being *less than six (?) months and less than the duration of the disease causing death.*

NOTE.—The limit of residence is suggested merely as a basis for discussion. Evidently, some line of demarcation should be fixed if it is proposed to treat deaths of non-residents upon a uniform basis. In addition to the duration of the disease causing death, its period of incubation may be considered as a factor of the decision. But, whatever plan is adopted for the special statement of deaths of non-residents, there should be no interference with the complete statement of total deaths, inclusive of all deaths of non-residents, as required by paragraph 10.

Deaths in Institutions.

12. Deaths of residents of a city in a hospital or institution situated within the city limits should be distributed by the local registrar to the districts of residence (borough, ward, sanitary district) as far as possible.

13. Deaths of residents of a city in an institution (*e.g.*, almshouse) situated outside of the city limits, but chiefly or entirely occupied by commitments from the city, should be included in the total deaths of the city, and be distributed by the city registrar to the districts of residence as provided in paragraph 12.

NOTE.—This is suggested for discussion. It apparently departs from the general principle of registering a death where it occurs, and there only. On the other hand it would relieve extra-urban districts containing city institutions from an apparently excessive mortality, enable the true death-rate of the city to be known, and make the statistics more comparable with future years when, with the extension of the city limits, the institution may come to be included in the urban area. The successful accomplishment of such distribution requires co-operation of local registrars, and would evidently be undesirable and

unfair unless all cities included the deaths of their dependent or defective classes on the same basis. A limit of residence might require to be considered.

14. Deaths of inmates of a State or government institution should be included in the total deaths of the areas containing them; but special columns may be employed to permit the separate statement of such deaths, as in the case of non-residents.

NOTE.—The alternative plan of distributing the deaths in a State institution (*e.g.*, insane asylum) to the counties or cities from which the inmates were received may be considered, or the institution may be treated as an independent registration area. In any case, if the deaths are eliminated the constituent population should also be eliminated before computing death-rates.

Deaths on Trains or Vessels.

15. Passengers dying on trains or vessels should be registered as deaths at the station or port where the bodies are removed.

NOTE.—Such cases are few, and the rule is suggested to secure early registration at the nearest practicable point to the place where death occurred. These deaths may be treated as those of non-residents (paragraph 10), and it is desirable that a record, not for statistical purposes, be made at the place of residence.

16. Deaths caused by railroad accidents or by disasters incident to navigation should be registered in the district that includes the place of death or where the bodies were brought ashore.

Deaths at Sea.

17. (Subordinate to 15, 16.) In deaths and burial at sea, or in marine disasters where the bodies are not recovered, the deaths should be registered at the port of embarkation; and for this reason a register should be kept at the shipping office of all sea-going vessels containing the essential particulars concerning each member of the passengers and crew. Such deaths may be separately noted in the statistical tables of the port of embarkation.

Period Covered.

18. Total deaths should include all deaths that occurred in the given area during the period stated in the table, and no others:—

(*a*) A weekly bulletin should include all deaths that occurred during the week ending at 12 P.M., Saturday, and no others.

(*b*) A monthly bulletin should include all deaths that occurred during the calendar month, and no others.

(*c*) An annual report should include all deaths that occurred during the calendar year, and no others.

NOTE.—The basis of compilation should be the occurrence of the deaths, not the time of receipt in the registration office. No allowance or "offsetting" need be made for "delayed returns" in a fully effective administration of a State or city office.

Headings of Tables.

19. Every table of total deaths should explicitly state in its heading that still-births are not included, and, if any classes of deaths are omitted

from a table apparently relating to total deaths, the items excluded should be explicitly stated either in the heading or in a foot-note.

Death-rates Based on Total Deaths.

20. Any statement of the death-rate (general, crude, or gross death-rate) of a State or city should be understood to be based, unless expressly qualified, upon the *total deaths, exclusive of still-births,* and without any omissions of deaths whatsoever.

Viability or Non-viability.

CASE. (Richmond, Va., 1907).—"We have a death certificate in which the cause of death is stated as 'premature birth, non-viable,' and the contributory cause is given as 'typhoid fever (mother).' The doctor states to me that this was a six-months' child that gasped a little for three hours, and that he did not consider the child viable when born. What shall we do with this case? Shall it be counted as a death? If so, we are, of course, entitled to the birth at least, and yet the child is distinctly stated to be non-viable. Have you any rule as to what age children are considered viable?" This case presents some interesting features, and, in order to bring out the general opinion and practice of registration officials, the following proposed ruling is formulated:—

21. Statement of viability or non-viability of an infant prematurely born shall not be considered in classification. The case above should be compiled (paragraph 5) both as a birth and as a death.

NOTE.—With the adoption of improved methods of caring for prematurely born infants (incubator), undoubtedly many lives may be saved that would formerly have been considered "non-viable." The better practice is, as stated by the American Text-book of Obstetrics, vol. ii, p. 387: "It has been customary to fix the period of viability at twenty-eight weeks. As a number of premature infants of twenty-four weeks have successfully been raised, the suggestion that any child that breathes at birth be treated as viable should be adopted in place of any fixed rule based upon the age of the fetus or upon its size."

(4) STATISTICAL DEFINITION OF STILL-BIRTHS.

1. For registration purposes, still-births should include all children born who do not live any time whatever, no matter how brief, after birth.

NOTE.—This definition includes children dead some time before birth, as well as children alive immediately before birth, but who die during the process of birth and before its completion.

2. Birth (completion of birth) is the instant of complete separation of the entire body (not body in the restricted sense of trunk, but the entire organism, including head, trunk, and limbs) of the child from the body of the mother. The umbilical cord need not be cut or the placenta detached in order to constitute complete birth for registration purposes. A child dead or dying a moment before the instant of birth is a still-birth, and one dying a moment, no matter how brief, *after* birth, was a living child, and should not be registered as a still-birth.

3. No child that shows any evidence of life after birth should be registered as a still-birth.

NOTE.—The usual evidence of life is breathing, but beating of heart or any other sign of life after birth should be accepted, as well as the fact of respiration or crying out, to determine that the child was not still-born.

4. Still-births should not be included in tables of births or in tables of deaths. They should be given in separate tables of still-births.
5. Still-births may be registered either (1) with births, (2) with deaths (3) with both births and deaths, and (4) separately as still-births.
6. Registration as both births and deaths is preferable, in which case the returns should be compared, a correct list of still-births made, and the corresponding certificates eliminated from the births and from the deaths for purposes of compilation.
7. Midwives should not be allowed to sign certificates of still-births.
8. It is not advisable to fix a lower limit of utero-gestation below which still-births need not be registered.
9. For comparative statistical purposes still-births should relate to a definite period of utero-gestation; for example, from the seventh month.

NOTE.—There is evidently no propriety in comparing returns of still-births from a city which registers them as far back as the fifth month with another in which only those after the seventh month are recorded. An effort might be made to secure a complete record, by double registration as birth and death, of all after the seventh month, registering also any cases before the seventh month, but not including them in the ordinary tables of still-births.

10. All birth certificates that may be used for the registration of still-births should provide for the time of utero-gestation, if less than full term.

(See also paragraphs 2 to 9 in preceding section on deaths.)

(5) STATISTICAL DEFINITION OF BIRTHS.

1. "Births" should be used to denote children born alive only, so that it should not be necessary to specify "living births."
2. Whenever, under the foregoing rules, a death should be registered, there should be a corresponding registration, at some previous time, of a birth; and whenever a still-birth is registered, it should be rigorously excluded from both the statistics of births and of deaths.

(See preceding paragraphs relating to deaths and still-births.)

(6) ESSENTIAL REQUIREMENTS FOR REGISTRATION OF DEATHS.

NOTE.—These are merely presented for reindorsement (see Census circular No. 71) and for comparison with the proposed essential requirements for the registration of births.

1. Deaths must be registered immediately after their occurrence.
2. Certificates of death [of standard form] should be required.
3. BURIAL OR REMOVAL PERMITS are essential to the enforcement of the law.
4. Efficient local registrars are necessary.
5. The responsibility for reporting deaths to the local registrars should be fixed.
6. The Central Registration Office should have full control of the local machinery, and its rules should have the effect of law.
7. The transmission and preservation of returns should be provided for.
8. Penalties should be provided [and enforced].*

* The words in brackets have been added.

(7) ESSENTIAL REQUIREMENTS FOR REGISTRATION OF BIRTHS.

1. Births must be registered immediately after their occurrence.
2. Certificates of birth of standard form should be required.
3. SOME CHECK is necessary to secure enforcement of the law.
4. Efficient local registrars are necessary.
5. The responsibility for reporting births to the local registrars should be fixed.
6. The Central Registration Office should have full control of the local machinery, and its rules should have the effect of law.
7. The transmission and preservation of returns should be provided for.
8. Penalties should be provided and enforced.

NOTE.—The character of the check mentioned in paragraph 3 is left for consideration in connection with an analysis of present methods.

(8) METHOD OF TESTING ACCURACY OF REGISTRATION OF DEATHS.

1. The accuracy (completeness with respect to total number) of the registration of deaths in a State may be satisfactorily determined by the proportion found actually registered out of a sufficiently large number (10 per cent. of the total?) derived from any independent source,—*e.g.*, newspaper reports,—and properly distributed throughout the State.
2. Local registrars should regularly note newspaper reports of deaths in order to detect omissions and secure complete registration.

NOTE.—The Registrar-General of England and Wales in his "General Rules concerning Registration of Births and Deaths" directs that the local registrar "should also systematically consult the announcements of Births and Deaths in the local newspapers."

(9) METHOD OF TESTING ACCURACY OF REGISTRATION OF BIRTHS.

1. The accuracy (completeness with respect to total number) of the registration of deaths in a State may be satisfactorily determined by the proportion found actually registered out of a sufficiently large number (10 per cent. of the total?) derived from any independent source; *e.g.*, newspaper reports or lists of infants registered as deaths, and whose certificates of death enable the place and date of birth to be fixed, provided they are properly distributed throughout the State.

(10) CONSTITUTION OF STANDARD TABLES OF VITAL STATISTICS.

1. Every State or city registration office publishing an annual (or biennial) report should include therein a table showing the population (properly estimated for intercensal years), total number of births exclusive of still-births, total number of deaths exclusive of still-births, total number of still-births, total number of marriages,* and total number of divorces,* for each year of registration.
2. It is desirable that the corresponding rates be given, but the primary figures should be presented whether it is possible to present rates or not.
3. Notes should be given in all instances when discrepant figures have

* Providing these items can be obtained.

been officially printed relative to returns for any year, and the correct figures should be definitely stated.

4. Notes should be given on changes in methods of compiling still-births, and a correct statement of still-births should be established for each year, on the basis of the definitions approved. If necessary, re-examination of the original returns should be made for the purpose of obtaining comparable figures.

(11) ADOPTION OF UNIFORM AGE PERIODS IN MORTALITY STATISTICS

1. In primary or general tables of deaths, ages should be given in quinquennial periods throughout, with subdivision of the first quinquennial period into individual years, except that all ages over one hundred years may be stated in one group.

2. Age periods should always be stated as both inclusive; thus, 5–9 means the years 5, 6, 7, 8, and 9.

3. Unknown ages should never be accepted in returns. The approximate age, according to the best judgment of the reporter, should be given if the exact age is unknown. When accepted by the central registration office, however, they should be given a place in the statement of ages in order to show the imperfect quality of registration.